Department of Mines Western Australia

Annual REPORT

1990-91

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Department of Mines, Western Australia

Honourable Gordon Hill JP MLA
Minister for Mines
Parliament House
PERTH WA 6000

Dear Minister

In accordance with Section 62 of the Financial Administration and Audit Act 1985, I submit for your information and presentation to Parliament the Annual Report of the Department of Mines of the State of Western Australian for the year ending June, 1991.

The Annual Report has been prepared in accordance with the provisions of the Financial Administration and Audit Act 1985.

The Report uses the format established in previous years, with the Department's activities described under Corporate Programs. These are set against a background of the mining and petroleum industry in 1990-91.

Information of a more general nature about this Department and its activities will be published later in the year as an Annual Review.

I commend to you the loyal and responsible contribution of officers from all sections of the Department towards the implementation of Government policies.

Yours sincerely

D. R. Kelly

D R Kelly
DIRECTOR GENERAL OF MINES
August 1991

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DEPARTMENT OF MINES, WESTERN AUSTRALIA ANNUAL REPORT 1990-91

Director General of Mines' Report

In a difficult year for all sectors of the Western Australian economy, the mining and petroleum industry again underwrote the employment opportunities and standard of living of all West Australians.

The industry has become the backbone of the State economy, and this will continue for the forseeable future. The mining and petroleum sectors are also vital to us all as they alone can provide the export income needed to repay Australia's foreign debt.

The importance of the industry is underlined by the fact that in a year when most sectors experienced decline, the total value of production rose to $12.5 billion, an increase of 20% over 1989-90. An impressive result.

Mineral and petroleum output was at record levels with more than 80% of production exported to provide around 70% of WA's export earnings. If this trend continues Western Australia will provide about 40% of the nation's total mineral and energy exports in 1991-92.

The expansion and the changing nature of operations in the mining and petroleum industry impacted on the Department of Mines. Increasing community expectations in the vital areas of conservation and safety have added to the workload of the Department. The industry too, has placed increasing demands on the Department for a level of service and operational efficiency to match its own growth and technological advances.

All nine divisions of the Department have been affected. At a time when the public sector has been under pressure to reduce numbers, raise productivity and increase cost efficiency, I am pleased to say the Department has met the challenges with a positive, dedicated across-the-board effort from all divisions.

The Department's commitment to Corporate Planning continued with the introduction of Program Management, resulting in the comprehensive integration of corporate planning and the budgeting process. A number of strategies and specific actions to address key issues confronting the Department were identified and goals set, with special emphasis on the environment and the safety of mineral and petroleum industry workers. An operational plan is currently being developed to ensure optimum utilisation of all available resources in meeting industry and public demands. This Annual Report provides a comparison of planned achievements and outcomes based on the plans to enable the reader to judge how effectively we met our goals.

A major focus of the Department's activities remains the safety of all mining and petroleum operations for workers and the public. Despite a heartening downward trend in the long-term rate of incidents, the Department remains very concerned with the number of fatalities in the mining sector. During the year an inquiry, chaired by the Director of the Mining Engineering Division, was completed on safe working practices in underground gold mines. The recommendations contained in the report are now being implemented. The Department is hopeful that co-operation between industry organisations, the unions and companies will see a reduction in the number of fatalities along with the overall long-term reduction in lost time injuries.

The Government has since established a broader enquiry into the health and safety legislation governing the mining industry and the administration of that legislation. The enquiry is being conducted by Mr E R Kelly, former Chief Commissioner of the Western Australian Industrial Relations Commission. The Department is co-operating fully with Mr Kelly and has produced a detailed submission for his consideration.

The problems of open pit wall stability were exhaustively addressed by the Geological Survey Division with the production of guidelines and an extensive industry education program. The status of radiation safety in the mineral sands industry was closely examined in the Technical Audit Team report of September 1990, which had as its major finding that regulatory surveillance by the Department of Mines had been very effective and that the numerous initiatives in radiation safety by the Department had been highly successful.

Increased emphasis on the environment and land rehabilitation generated an increasing workload for the Department, especially for the Mining Engineering and Petroleum divisions. However, all challenges were met, a number of positive initiatives taken and some excellent results produced. Five new environmental officers, four in the Department's Mining Engineering Division and one in the Petroleum Division, were appointed.

Through the work of the Environmental Officers, a number of guidelines and reports were produced.

These included guidelines for the environmental management of quarries, and the design and rehabilitation of tailings dams and waste dumps. Additionally, schedules of specific requirements for onshore and offshore petroleum exploration and production, with environmental impact assessment checklists, were produced.

In other environmental initiatives the Geological Survey Division had considerable input into the Government's new policy on exploration and mining in conservation areas, the Chemistry Centre continued its comprehensive cyanide monitoring programs and Explosives and Dangerous Goods Division staff ensured that the transport and storage of dangerous goods met all Environmental Protection Authority requirements.

Access to land for exploration and mining remained a key issue for the mining and petroleum sectors during the year. Following extensive consultation the Government announced a new policy on access to areas of conservation value. Under this policy, known as Resolution of Conflict, exploration and mining will in the future be banned in National Parks. For Conservation Reserves, working arrangements have been developed for assessment of conservation and environmental issues. Assessment will be undertaken by the Mines Department in consultation with the Departments of Conservation and Land Management, and the Environmental Protection Authority. These processes should expedite consideration of mining tenement applications.

The industry experienced significant problems during the year with access to Aboriginal Reserves and site clearances. Major resource projects were delayed and to overcome this impasse a Development Policy Ministerial Council was established. It is expected that it will produce a set of guidelines for use by industry, Government departments and local Aboriginal communities.

In early January, the Department's Explosives and Dangerous Goods Division in conjunction with the Police, conducted a "blitz" on vehicles transporting dangerous goods, thereby raising awareness among operators of their responsibilities in safeguarding the public from any hazards. The division also spent considerable time in the assessment of hazard levels at the State's ports for the import and storage of ammonium nitrate. The process of drafting the new Dangerous Goods Regulations continued.

Initiatives by the Department to facilitate the exploration and development of natural resources and to provide a more efficient and effective service to the industry included the further development of computer-based programs and the streamlining and updating of operations, especially in the Surveys and Mapping and Mining Registration divisions.

Ultimately,a suite of computer database programs including WAMEX, WAPEX, MINEDEX, ROCKMIN, TENDEX and TENGRAPH, will provide significant benefits to industry by releasing data vital to exploration programs and providing details in both data and graphic form of the status of mining tenements across the State. Work also continued on a Geographic Information System that will assist the resolution of complex environmental, planning and Aboriginal issues and assist industry in speeding up the planning process.

A significant stimulus to the mineral exploration industry came in September 1990 with the release of the landmark publication "Memoir 3 — Geology and Mineral Resources of Western Australia". The definitive reference for those interested in the geology of the state, it is the culmination of 15 years of research and mapping by over 50 geoscientists in the Geological Survey Division.

The Surveys and Mapping Division, pursuant to the Department's overall information technology plan, introduced state-of-the-art technology. Computer-aided drafting and mapping will revolutionise the production of map products and the way the division's functions are structured, whilst the introduction of Global Positioning Systems will alter the face of surveying and ultimately lead to considerable cost saving. When fully operational the Landcap/Landraw system will result in major changes to traditional mapping by electronically generating plans and diagrams.

As part of an overall strategy to simplify operations the Department introduced graticular sections, dividing the State into 1.4 million regular blocks 1' x 1' in size. Consequently, mining exploration tenement applicants have certainty about the area they have been given to explore and the Mining Registration Division is able to supply a superior service to explorers. In a similar vein the Petroleum Division announced the creation of a new type of petroleum exploration lease, a Drilling Reservation, that allows exploratory drilling with a

limited tenure of 12 months without the onerous requirement of a 5-year financial commitment. These Reservations will complement the new system of basin-wide releases by allowing petroleum explorers to tailor their exploration to their financial capacity and priorities, and the geology of an area.

The Chemistry Centre continues to provide a wide range of analytical and research services. Activities undertaken included forensic science, drug detection, water analysis, food and soil pesticide checks, occupational health matters and consumer complaints. Soil and plant testing continued as did environmental health work and mineral science and metallurgy. Acquisition of new equipment, including as an X-ray diffractometer and an inductively-coupled plasma mass spectrometer, allowed the Centre to increase the diversity of the analytical and advisory services it gives to industry, Government and the public.

The total revenue collected by the Department or verified on behalf of the Commonwealth Government was $414.1 million. Of this $380.5 million passed through the State Consolidated Revenue Fund (CRF) and is hence reported upon in detail in the Financial Statements in this Annual Report. The CRF revenue collection was 19% higher than in the previous year and included $49.7 million lease fees and rentals and $6.4 million in charges and sales.

Royalties staff examined 500 royalty returns at the Department's offices or on-site, prepared audit manuals for the entire North West Shelf project and Barrow Island and negotiated with a number of mineral and petroleum producers to finalise issues involving significant royalty amounts.

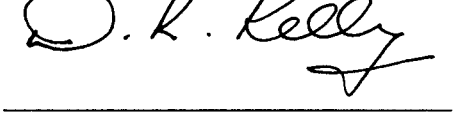
On the expenditure side, payments made by the Department from Consolidated Revenue amounted to $44.15 million, a fall over the previous financial year of some $700 000.This outstanding result reflects well on the expertise and dedication of all officers in the Department.

The drafting and amendment of legislation continued apace as the Department fulfilled its regulatory role and responded to industry and Government directives. Major changes in petroleum legislation were gazetted to be proclaimed later in the year as were changes to the Mining Act and Explosives and Dangerous Goods Act. Current mining legislation is working extremely well and many problems of past years have been eliminated.

During the year the Department experienced a reduction in staffing levels due to restraints on recruitment and the closure of the Drilling Branch. This brought to a close an activity of the Department which began in the 1950s, when the need for information on groundwater reserves in the Collie coalfields saw the creation of the branch. In subsequent years the Drilling Branch was successfully involved in a variety of programs to define and monitor groundwater reserves across the State. Through its efforts many rural communities today have adequate supplies of potable water.

The staff turnover rate fell 13% with 137 staff resigning or retiring compared with 157 in the previous year. Restrictions on the filling of vacancies however resulted in only 107 new staff being appointed. In 1990-91 the Department employed the equivalent of 765 full time staff compared to 795 in 1989-90. However, management and monitoring strategies developed as part of the Corporate Planning process proved their worth and the Department was able to optimise the use of its limited resources and undertake most programs without any serious reduction in the level of services provided. This was only made possible by a sustained effort from all divisions.

With reductions in Government funding and staffing levels, increasing demands from the mining sector and the need for an expanded effort in our safety and environmental programs, the Department faces a testing year ahead. I am certain our commitment to excellence and the dedication and professionalism of all officers will carry us through. The industry, public and Government can rest assured that the Department will strive to maintain service standards despite the financial and staffing reductions.



D R KELLY
Director General of Mines

Western Australia

The State's mining and petroleum industry continued its overall strong performance in 1990-91. At a time when most other sectors were in a severely recessed condition the minerals extraction and processing industry still dominated the State economy.

With an estimated value of mineral and petroleum production of approximately $12.3 billion, the financial year's result represented a 15% increase over 1989-90 (Figure 1).

Sustained growth by the major commodities of gold, petroleum and iron ore, and a strong performance by alumina, created the increase in the overall value of production (Figure 2). The percentage contributions to the overall value of output are shown at Figure 3. In what has been a declining market for mineral products, returns to producers were mainly determined by overseas market prices. The exchange rate was fairly stable due to relatively high domestic interest rates and, more recently, by a market perception that commodity prices have bottomed.

Alumina, heavy mineral sands and nickel all experienced falling worldwide demand during the second half of the year and this was reflected in some contraction in output. While alumina production increased slightly, output of the other two commodities decreased.

Overall, the minerals and petroleum industry in this State continued to post strong results despite the uncertainty prevailing in the international commodity trading markets. Essentially, the economic factors which drove the resources boom of the late 1980s have changed, with demand and prices stabilising at about their long-term growth rates.

The World Scene

The major OECD economies continued to show considerable diversity of performance in 1990-91. While overall economic growth was maintained, it slowed considerably as the US and the UK slipped into recession. While there have been some indications of economic recovery in the US, consumer confidence, financial markets and most industrial activity remains subdued.

The very important Japanese and German economies, which grew strongly through the third quarter, both began to slow as the financial year ended. Though their economies are beset by different structural and institutional problems, the respective governments are resisting pressure to lower interest rates because of fears over the inflationary effects of further money supply growth.

The sensitivity of Western Australia's minerals and petroleum industry to developments in key international markets, such as the US, was again brought home to the State's producers.

While a dependence on the export of bulk commodities will no doubt prevail for some time to come, growth in downstream processing capacity and significant improvements in Australia's investment environment augur well for the future. Prominent among the improvements are lower inflation and interest rates, and a progressing agenda of microeconomic reforms. All of these factors will increase the efficiency and international competitiveness of Australia's minerals and petroleum industry.

Commodity Analysis

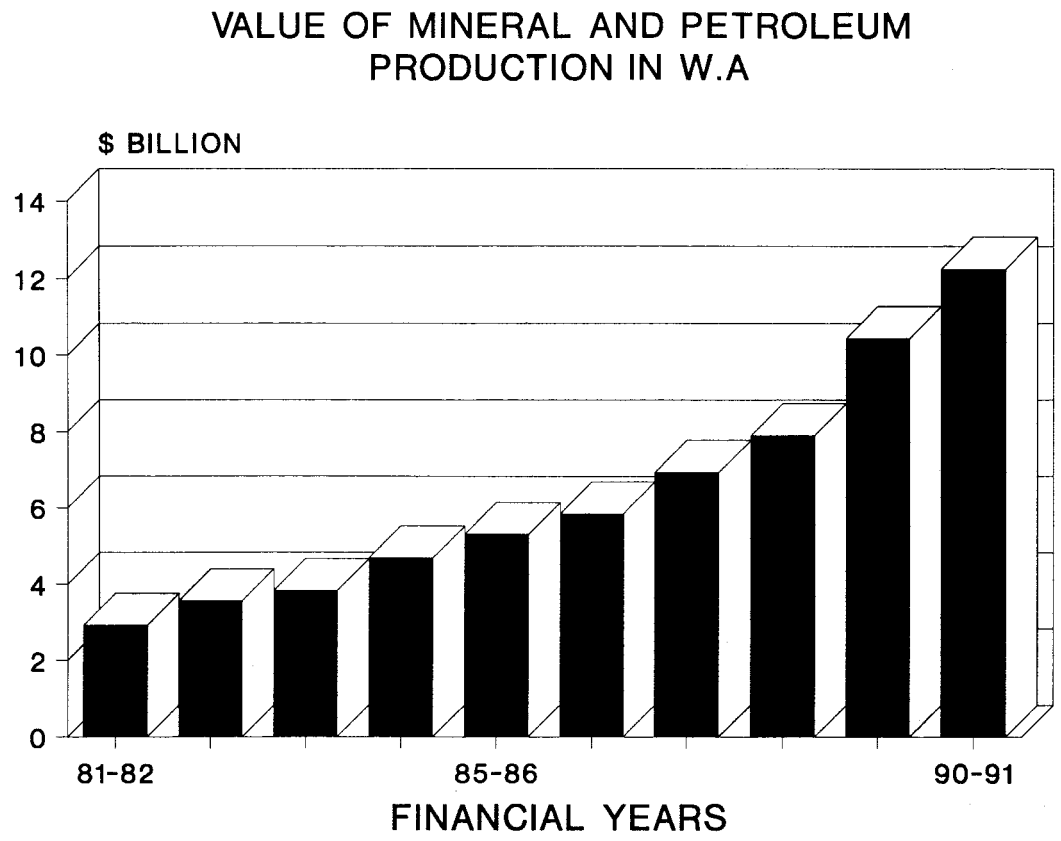
Gold

During 1990-91 production continued to rise with reported output at over 181 tonnes.

This figure represented a 19 tonne increase (12%) for the financial year. The estimated value of production was $2.9 billion based on average monthly international gold prices. Given some forward sales by producers at higher prices the actual revenue received by gold producers was probably in excess of $3 billion.

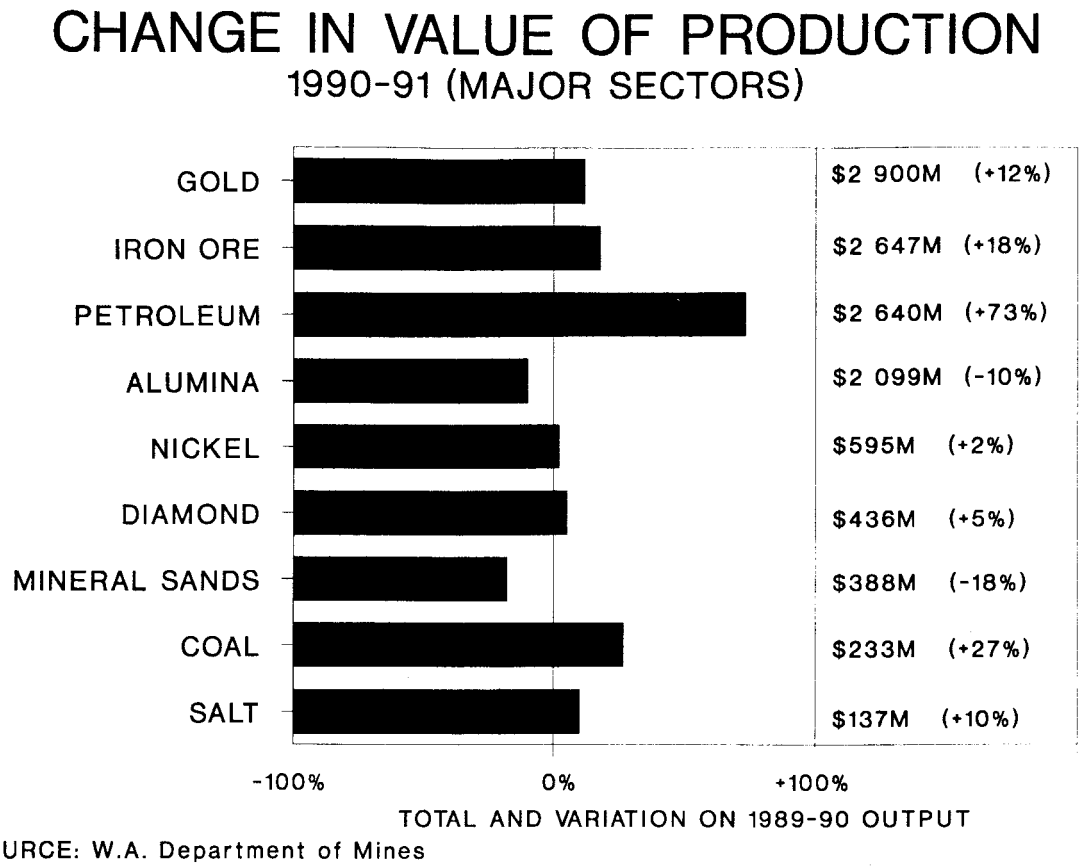
The outstanding result was achieved despite capital raising problems for explorers and mine developers, fluctuating demand and a generally weakening real price for the precious metal.

The price rise which occurred in August 1990, as a result of the beginning of the Gulf crisis, was not sustained. As the industrial world's oil supplies were seen to be secure, financial markets quickly discounted the longer term effects of the conflict, and hence the gold price. The price came under further pressure through the simultaneous speculative dumping of large amounts of bullion onto world markets.



SOURCE: W.A. Department of Mines

Figure 1



SOURCE: W.A. Department of Mines

Figure 2

Gold traded in a fairly narrow price band for most of 1990-91 (Figure 4).

The continued growth of the jewellery fabrication industry, central bank purchases and some tendency towards hoarding have placed a price floor of approximately $US350 per ounce under gold sales.

As annual demand from jewellery manufacturers has for several years exceeded output this industry is most important in improving the current supply/demand balance for the precious metal.

Despite the strong performance posted in 1990-91 the Western Australian gold industry is under pressure from a range of financial and technical factors.

Falling world prices, higher operating costs in Australia and the end of the industry's tax exemption status on 1 January 1991 have placed considerable financial pressure on producers.

The difficulties experienced by small companies in raising capital since the October 1987 stock market crash has combined with the financial factors to reduce exploration expenditure.

The resulting decrease in new discoveries, along with the accelerated processing of reserves prior to the changes in taxation arrangements and lower profits has led to a rationalisation in the industry. Larger projects are taking over smaller operations to achieve greater throughput for their mills and longer operating lives.

With reduced reserves there is a necessary move towards deeper decline developments and the processing of sulphide ores.

Companies are addressing the issue of higher associated costs with stringent cost reduction methods and technological innovations. The process of rationalisation has reached an advanced stage, with progressively fewer obvious targets for takeover remaining amongst the junior and medium-sized producers.

Petroleum

Petroleum's rapid growth in production and total value of output was sustained in the past financial year. Crude oil, condensate and LNG production all increased significantly while domestic natural gas sales were fairly stable. Total value of production was over $2.6 billion.

Crude oil output rose by 17% to over 5 million kilolitres and condensate sales posted a 11.5% increase to 1.8 million kilolitres. The total receipts from these two products was over $1.4 billion.

The massive North West Shelf LNG export project continued to gain momentum with the amount shipped rising by 78% and the value of that production more than doubling to $836 million. This project is well advanced towards meeting its mid-decade target of sales to the value of $1.5 billion per annum.

Developments in 1990-91 have confirmed the offshore North West Shelf and the Timor Gap regions as Australia's principal future petroleum provinces.

An agreement on the boundaries and administration zones of the Timor Gap area was signed between Australia and Indonesia in late 1990. Negotiations are proceeding for companies seeking to gain exploration access, particularly to the jointly administered Zone A.

In addition to the two relatively small offshore oil projects of Yammaderry and Cowle, which came on stream in early 1991, several other large North West Shelf projects advanced during the past 12 months.

The $140 million gas gathering project centred on the Harriet field received the go ahead in December 1990 and the first delivery to SECWA is scheduled for 1992. A commitment was made in April 1991 to proceed with the development of the Cossack field, and the Goodwyn A production platform and associated third LNG train are progressing. Announcements are expected in the near future on the large Wanaea and Griffin fields.

Western Australia will attract a large proportion of the nation's exploration and development investment in 1991 thus creating the potential for further future expansion in this sector.

Iron Ore

Western Australia's iron ore industry continued to be buoyed by the resilient demand prevailing in the economies of its main customers. Exports to the relatively new markets of China, the Republic of Korea and Taiwan were the main growth areas although Japan

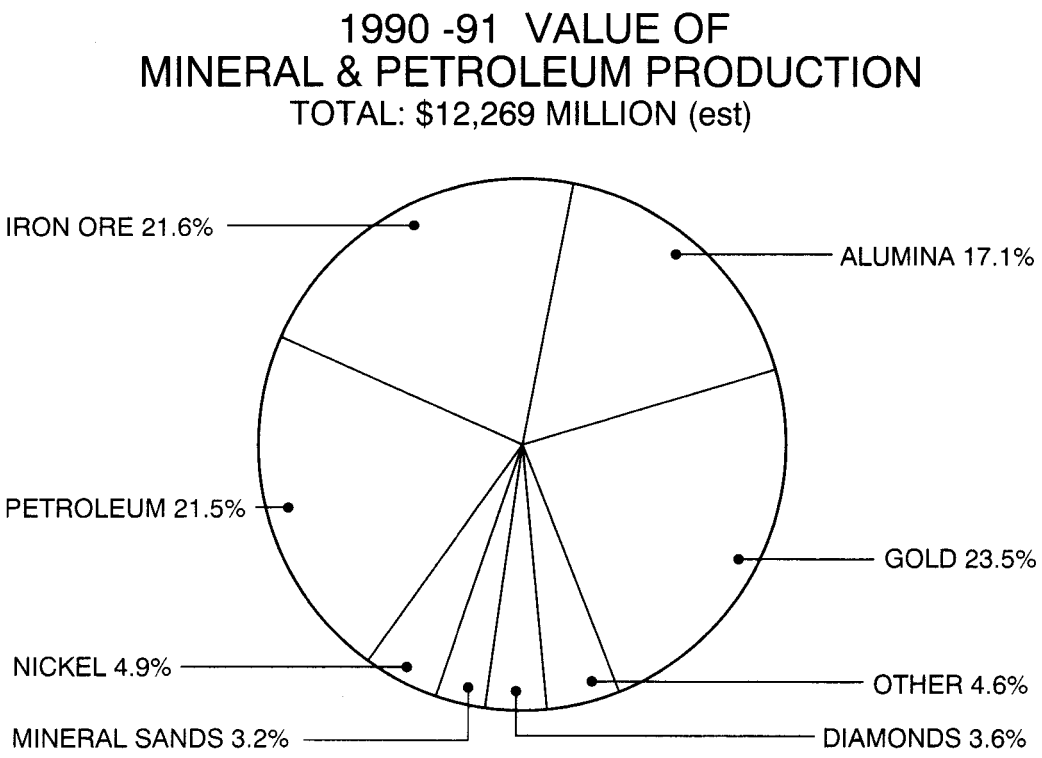


Figure 3

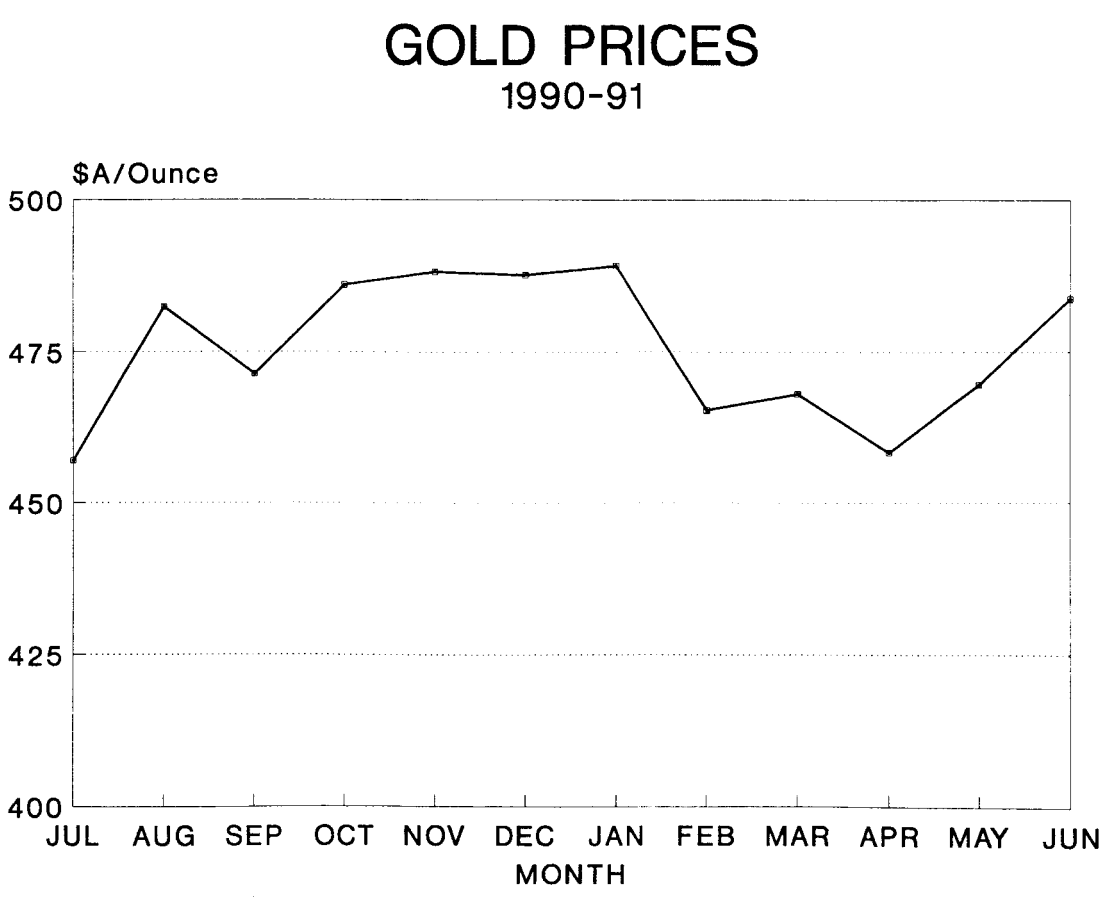


Figure 4

remained the principal consuming country of Western Australian iron ore.

Production for domestic and export markets was relatively unchanged from the preceding trading period at around 107 million tonnes. The value of this output did, however, increase to over $2.6 billion, a substantial 18% rise.

Helped by strong demand from North Asia and relatively tight global ore supplies, the State's producers were able, in early 1991, to negotiate a third consecutive annual price rise. The 7% increase kept pace with Australian inflation and hence production costs.

The medium to longer term demand for steel in the developing East and North Asian countries has encouraged Western Australia's producers to look past the current economic downturn. Investment in existing and new projects is strong across the whole industry. Significant mining and port investment should lift Robe River Mining Associates' production to over 30 million tonnes during the current trading period. Mount Newman should return to its 'normal' production level of 35 million tonnes per annum in 1991. The 5 million tonnes per annum Yandicoogina project commenced construction early in 1991 and Hamersley Iron's Brockman Number 2 detritals project will also begin in 1991. Both projects should be producing by 1992.

Hamersley's large Marandoo project is progressing, albeit with some difficulty, and it is expected to begin supplementing Mount Tom Price production by early 1994. As the State's principal producer Hamersley Iron will be striving to maintain output at around 47 million tonnes per annum.

Domestic consumption of West Australian iron ore is not expected to increase significantly before Australia begins to emerge from the current recession with use continuing at around 5 million tonnes per annum.

Alumina

Despite a marginal increase in State production of 150 000 tonnes to 6.8 million tonnes, the value of sales dropped 10% to $2.1 billion. The fall reflects further reductions in international prices from the very high levels reached in early 1990.

Export unit value for the year averaged $310/tonne and is forecast to slip further to $290/tonne in 1991-92 before recovering (Figure 5).

Prices were driven down by a combination of weak consumption growth and slow supply response. With a flat demand for aluminium metal prevailing in the world, and particularly Australian, supply growth is adding to stocks and placing downward pressure on prices for alumina.

Prices are predicted to recover in 1992 and through 1995-96 the real value of alumina exports should increase by nearly 3% per annum.

This optimistic medium to long-term outlook has encouraged Western Australia's producers to undertake extensive investment programs. After operating at capacity for the past three years they are proceeding with significant expenditure.

The eighteen-month program of upgrading equipment and 'debottlenecking' at the Worsley operation will be completed in late 1991. In addition the company is undertaking an intense feasibility study into increasing capacity by 50% to an annual output level of 2.25 million tonnes.

After a considerable period of evaluation and planning, Alcoa began construction of Stage 2 of its Wagerup refinery in late 1990. This 40% expansion to 1.48 million tonnes per annum should be completed within 12 months and will involve a capital expenditure of over $300 million.

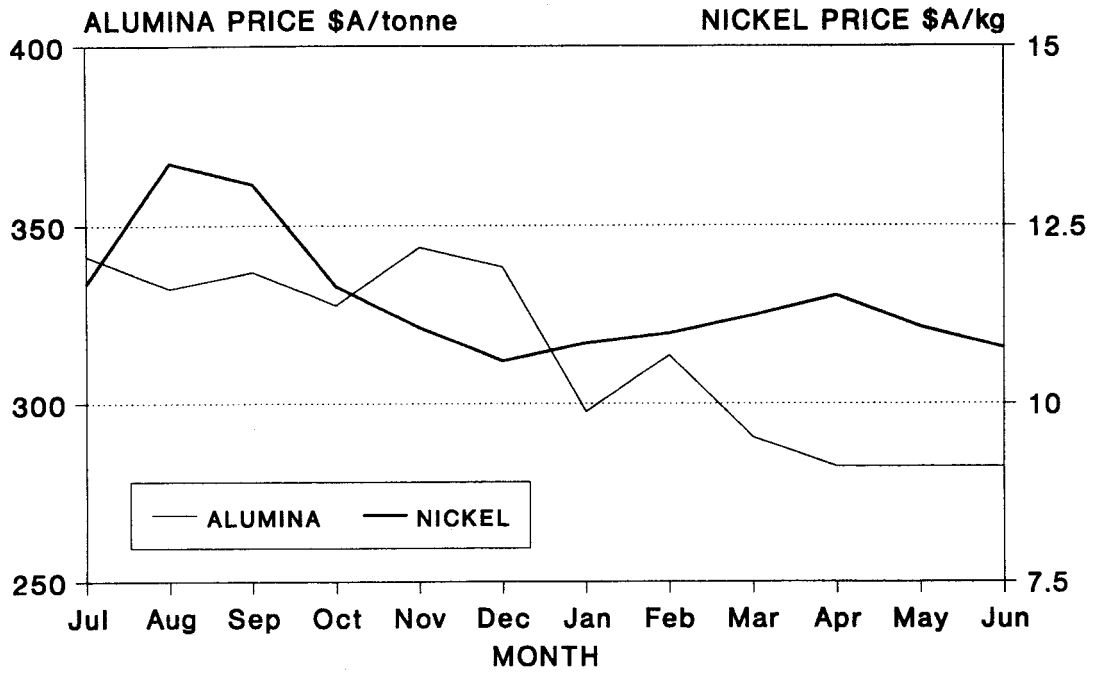
Western Australia's two producers should continue to supply a significant proportion of world markets though the 1990s.

Nickel

Production of nickel rose by nearly 10% to approximately 54 000 tonnes during 1990-91. Increased production from Western Mining Corporation's Leinster mine accounted for most of the rise, as Kambalda was stable and the Windarra mine continued to wind down.

As production rose, the total value of the sector's output also increased by approximately $10 million to $595.8 million.

ALUMINA/NICKEL PRICES
1990-91



SOURCE: ABARE Average Alumina Price,
LME Average Spot Nickel Prices.

Figure 5

W.A. MINERAL & PETROLEUM EXPLORATION EXPENDITURE
JULY 1990 - MARCH 1991

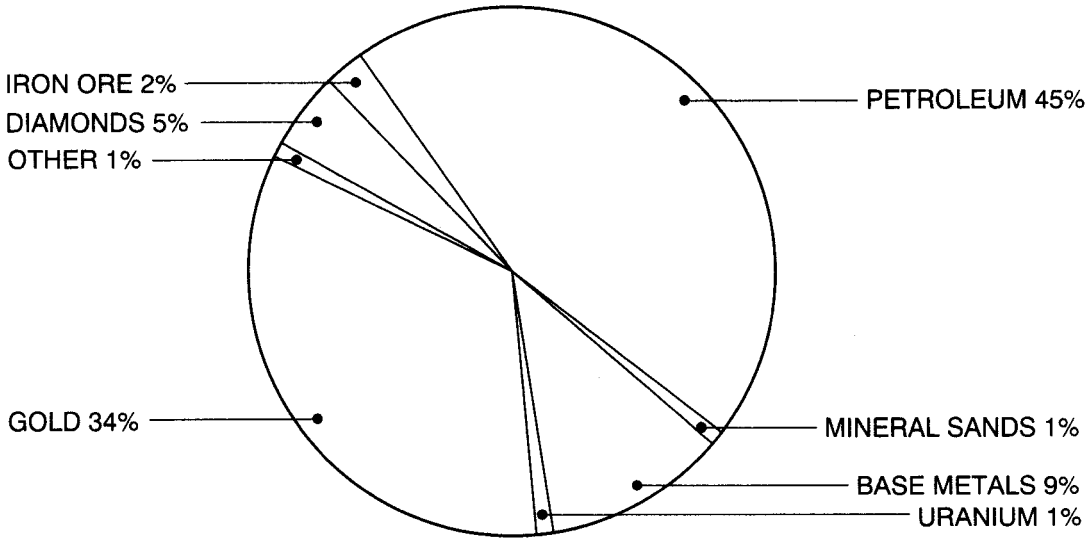


Figure 6

Nickel producers and investors were encouraged, however, as the steady price fall of 1990-91 stabilised and then rose slightly in the June quarter (Figure 5). Analysts have pointed to the historically low stock levels, which are now prevailing, and supply uncertainties as the reason for the price recovery. It is predicted that nickel prices will increase further by the end of 1991.

These economic conditions have encouraged the active consideration of new mining and processing developments in the State.

The joint venturers in the massive Mount Keith project have agreed to continue to work on the development after the completion of additional metallurgical test work. Final revisions to the feasibility study will be carried out over the next few months and a timetable for the development will be announced at that time.

Progress towards development of the large Yakabindie project immediately to the south of the Mount Keith project has slowed through disputes over the presence of Aboriginal sacred sites in the mine area.

Western Mining Corporation's plan for expanding mine production, smelting and refining capacity is progressing slowly. Implementation of the investment program is contingent on negotiations over energy costs, work practice changes and pollution emission standards.

Development work on the relatively small Radio Hill project in the Pilbara is substantially complete. The plant should be commissioned by the beginning of October 1991.

Some increased export earnings from this industry are projected for 1991-92 as production rises and the metal price slowly increases.

Diamonds

The total number of carats of diamonds sold by the two West Australian producers decreased to 29.8 million carats. Estimated value of this production rose, however, by 4% to $432 million.

The demand for rough, near gem and gem quality diamonds decreased during the trading period as all three categories proved sensitive to slowing world economic growth.

The Central Selling Organisation managed to stabilise the market during a difficult year by restricting supply. A small price increase was also gained through the steady exercise of its market power.

Heavy Mineral Sands

The strong world demand for ilmenite, rutile and zircon, which was sustained during the past five years declined steadily in 1990-91. Due to the high stock levels prevailing in world markets for most mineral sands products, the State's producers cut output.

An 18% fall in the overall value of sales during the trading period reduced the State industry's income to approximately $388 million. The largest fall was in zircon (42%), with a smaller fall in the value of ilmenite (5%).

Mineral sands products, particularly zircon, have proven to be particularly sensitive to economic fluctuations. The price surge of the late 1980s has also encouraged substitution in a wide range of final products.

On the demand side, a price floor is being provided by key growth areas in modern industrial processes and products. Although prices are not predicted to recover to the highs of 1989-90 in the medium term, existing market values should stabilise in 1991-92 under the influence of international economic recovery. With a recovery in demand export volumes should increase during the next trading period. The medium to longer term outlook for the industry thus remains very promising.

Despite the current downturn considerable interest still exists for new development in the South West of the State. Furthermore, producers are taking a longer term view, with AMC's integrated mineral sands project, including the Eneabba West mine and Narngulu dry synthetic rutile plant, being commissioned in February 1991. The TiWest joint venturers commissioned the Cooljarloo mine in August 1990, the Muchea synthetic rutile plant in November 1990 and are nearing completion of the titanium pigment plant at Kwinana.

The heavy mineral sands industry continues to be a leader among extractive industries in adding value through downstream processing.

Other Minerals

Coal production rose by over 1 million tonnes (25%) in 1990-91. Under the terms of a reform agenda instituted by the State Government for the industry, aggregate production and prices should both fall in 1991-92.

Salt production increased by half a million tonnes and in value of production by $11 million.

Despite a reduction in copper, lead and zinc prices through the year, new capacity at the Golden Grove project should provide a sound basis for expansion in this increasingly important area of the mineral industry.

Minerals and Petroleum Exploration

In 1990-91 more than $305 million was spent on the search for minerals in Western Australia. This was a 3% decrease on the $315 million expended in 1989-90.

Petroleum exploration activity increased again on the particularly strong performance of the preceding financial year. The cost has been estimated to exceed $250 million. A total of 33 exploration wells and 43 development wells were drilled. Most of the drilling (62 wells) was concentrated in the northern part of the offshore Carnarvon Basin.

Seismic survey activity totalled 41 543 line kilometres, with the majority (40 586) being undertaken offshore. Of this total about 30 000 km was conducted in the offshore Canarvon Basin.

For minerals, exploration for gold continued to dominate accounting for 63% of the State total (Figure 6). While the aggregate amount spent on mineral exploration has fallen, a reasonably high level of activity is being maintained principally by companies with operating mines. One development in recent years has been the move to discover and prove up secondary deposits in order to provide feedstock for existing plant.

Economies of scale and the efficient use of all capital investment are essential for profitable gold mining in an era of falling real prices.

After a steady three-year growth in base metals and nickel exploration the amount spent in 1990-91 rose moderately. While interest has continued in copper, lead and zinc resources in the Pilbara and Kimberley, the evaluation of existing nickel deposits in the Eastern Goldfields and Yilgarn has absorbed a large amount of exploration funds during 1990-91.

Diamond exploration, which is the third largest sector for mineral exploration, began the financial year strongly but faded during the period. While the Kimberley region remains the focus of most activity the central and eastern Pilbara and parts of the Eastern Goldfields also attracted exploration interest.

Iron ore producers have devoted considerable funds to detailed exploration and delineation of known ore bodies during the past two years. These efforts have increased in line with the optimism in the industry to maintain and increase export volumes and market share in the longer term.

Although the heavy minerals sands industry has experienced some downturn in demand for its products, exploration activity in the sector remains quite strong. Most expenditure has been in the highly prospective South West of the State.

Enabling Legislation

The Department is established by the Governor pursuant to Section 21 of the Public Service Act 1978 and, in so doing, satisfies Section 11 of the Mining Act 1978.

Background

The Department was established on January 1, 1894 as the regulatory body to ensure the safe and orderly development of mineral resources in this State, and to allow the Government and the community to benefit from these activities. This is still the major role of the Department.

The Geological Survey, which had been founded six years earlier, was incorporated with the Department of Mines. This was closely followed by the establishment of a system of State gold batteries. In 1902 the Government Analyst's Laboratory was transferred to the Department and signified the start of another role — the provision of services to the mining industry.

These services have evolved with the technological growth of modern mining. As the industry became prominent and complex, regulatory functions demanded a wide range and depth of internal services and expertise. Consequently, many of the sections of the Department traditionally involved in regulation were able to provide further services in the form of technical advice, tenement maps, and safety recommendations. Progressively, this role has been extended and now the Department is called upon to provide services to the community beyond those exclusively related to the mining and petroleum industries, particularly in relation to chemistry and public safety.

Government policy aims to encourage investment in exploration, extraction and utilisation of the State's mineral and petroleum resources. Because of their major contribution to the economy for almost 100 years, mining activities have ramifications that reach directly or indirectly into the whole economic and social fabric of Western Australia. This is reflected in the wide range of activities currently administered by the Department of Mines.

Vision

The Department of Mines will be recognised for its commitment to excellence and quality in meeting the needs of the community, industry and Government in the areas of minerals and science.

Corporate Philosophy

Western Australia is fortunate in being endowed with abundant mineral and petroleum resources, held in trust by the Government on behalf of the community.

Recognising that the community requires mineral and petroleum products to sustain its standard of living, the Department of Mines has been given the responsiblity to ensure that the exploration for and development of these resources is carried out equitably, with due care for the environment and worker safety, and in the best interests of the commmunity.

The general principles and philosophies fundamental to the Department's role, programs, structure, functions and strategy are summarised hereafter.

The mineral and petroleum resources of the State are owned by the Crown, but are almost entirely explored for, and developed by, private enterprise.

Exploration and development are undertaken in an organisational framework controlled and directed by Government with appropiate recompense (benefit) to the wider community.

The mineral and petroleum industries play a major role in the economy of the State and a high level of exploration is essential to identify the mineral, petroleum and groundwater resources which will be required to sustain our economy and maintain our living standards.

Mineral and petroleum deposits are almost always difficult and expensive to find, small in size relative to the total land mass, finite, and non-renewable.

Mineral and petroleum deposits are assets only after they have been discovered and delineated, and the potential for an appropiate financial return provides the incentive to engage in high-risk exploration necessary to find them.

Mineral and petroleum developments are a temporary land-use and should be integral to the principle of multiple land-use.

Changes in the economy, technology, and geological understanding will lead to the reappraisal of previously tested ground; thus the potential of any area can never be totally written off and there is a need to ensure that information is not lost and as much land as possible is made available for exploration.

Geoscientific data available from studying the geological record are essential for general land-use planning (for planning and designing urban areas, dams, roads, ports and harbours); such information can also assist in understanding and predicting events associated with the Greenhouse Effect.

Chemical research and services at a high level of confidence and integrity are needed to ensure independent and standardised information is provided to the community.

Management and the workforce must work together to create a safe working environment.

Pubic safety is of major concern in relation to the transportation, storage and use of explosives and dangerous goods.

Resources allocated to the Department are to be administered efficiently according to the prevailing principles and standards expected of the Public Service.

The Department must respond quickly and effectively to changes required by the community through Government.

It is against this background and in this environment that the Department must operate.

ROLE

The role of the Department is to ensure that the community of Western Australia:

- Receives maximum benefit from the responsible exploration and development of minerals and petroleum with proper regard to the protection of the environment;
- Is protected from hazards associated with mineral and petroleum activities, explosives and dangerous goods;
- Has access to independent geotechnical, chemical and engineering advice relevant to land-use planning, and the mineral and petroleum industries;
- Is provided with information about the geoscientific environment including the distribution of mineral, petroleum and groundwater resources; and
- Is provided with independent chemical research, consultancy and analytical services.

PROGRAMS:

In its defined role the Department of Mines carries out certain programs, as follow:

1 Minerals and Petroleum Titles Program

The objective of this program is to ensure that exploration and development titles for minerals and petroleum are issued fairly and without delay.

1.1 Titles System Sub-Program

Provides an equitable system for granting secure exploration and development titles as a basis for petroleum and mineral assessment and production.

1.2 Dispute Management Sub-Program

Minimises potential for disputes over exploration and development titles and facilitates the prompt settlement of disputes when they do arise.

2 Exploration and Development of Natural Resources Program

The objective of this program is to foster and assist responsible mineral and petroleum exploration and development, groundwater assessment, and land-use planning by providing high-quality scientific and technical services and advice to industry, Government and the public.

2.1 Geological Data Collection Sub-Program

Meets the need for geoscientific mapping, research, and resources assessment required to produce up-to-date maps, reports, and advice on the geology of the State and its mineral, petroleum and groundwater resources.

2.2 Metallurgical and Analytical Services Sub-Program

Provide mineral and metallurgical analytical and research services.

2.3 Geoscientific Data Dissemination Sub-Program

Provides timely dissemination of scientific and technical data from company exploration activities and Departmental studies.

2.4 Geotechnical and Mining Engineering Advice Sub-Program

Meets the need for geotechnical, geoenvironmental, hydrogeological, and mining engineering advice and services.

2.5 Community Relations Sub-Program

Fosters a favourable climate in the community for mineral and petroleum exploration and development.

3 Environmental Protection and Rehabilitation Program

The objective of this program is to ensure that proper attention is given to the protection and rehabilitation of the natural environment as it may be affected by mineral and petroleum exploration and development, and to facilitate the protection of groundwater resources.

Also the program provides chemical services for environmental management plus geological and mineral resource information and advice for planning and management of National Parks and Conservation Reserves.

4 Community Benefits Program

The objective of this program is to ensure that the community receives a fair return from the extraction of the State's mineral and petroleum resources.

It ensures that royalty collection is carried out in an economically and administratively efficient manner.

5 Worker and Public Safety Program

The objective of this program is to ensure that all operations in the mining and petroleum industry, and activities involving explosives and dangerous goods, are conducted in a manner that is safe for workers and the public.

5.1 Worker Safety and Health Sub-Program

Maximises the safety and health of workers in the mining and petroleum industry.

5.2 Management of Dangerous Goods Sub-Program

Minimises hazards to the public from activities involving explosives and dangerous goods.

6 Chemical Services Program

The objective of this program is to enhance agricultural and industrial development, and the protection of community, consumer, environment and health standards by providing high-quality independent chemical services to Government, industry and the public.

7 Corporate Services Program

The objective of this program is to ensure that the human, financial and other resources of the Department are used efficiently and effectively to provide a service responsive to the needs of the community, industry and Government.

The Organisation

Minister

The Minister for Mines, the Honourable Gordon Hill, J.P., M.L.A.

Principal Officers

Dr D.R. Kelly, BE(Hons), PhD, FTS, MIE Aust.
DIRECTOR GENERAL OF MINES AND ACCOUNTABLE OFFICER
(Appointed by the Governor pursuant to Section 29 of the Public Service Act)

Dr C.D. Branch,BSc(Hons), PhD, FAusIMM.
ASSISTANT DIRECTOR GENERAL OF MINES

Mr L.C. Ranford, BSc(Hons).
ASSISTANT DIRECTOR GENERAL OF MINES

Dr P.E. Playford, BSc(Hons), PhD, MAusIMM.
DIRECTOR,
GEOLOGICAL SURVEY DIVISION

Mr I.Fraser, BSc(Hons).
DIRECTOR,
PETROLEUM DIVISION

Dr J.W. Hosking, MSc, PhD, FAusIMM, FRACI.
DIRECTOR,
CHEMISTRY CENTRE (WA)

Mr M.L. Meaton, BSc(Agric)(Hons), BEc.
DIRECTOR,
ROYALTIES AND POLICY DEVELOPMENT DIVISION

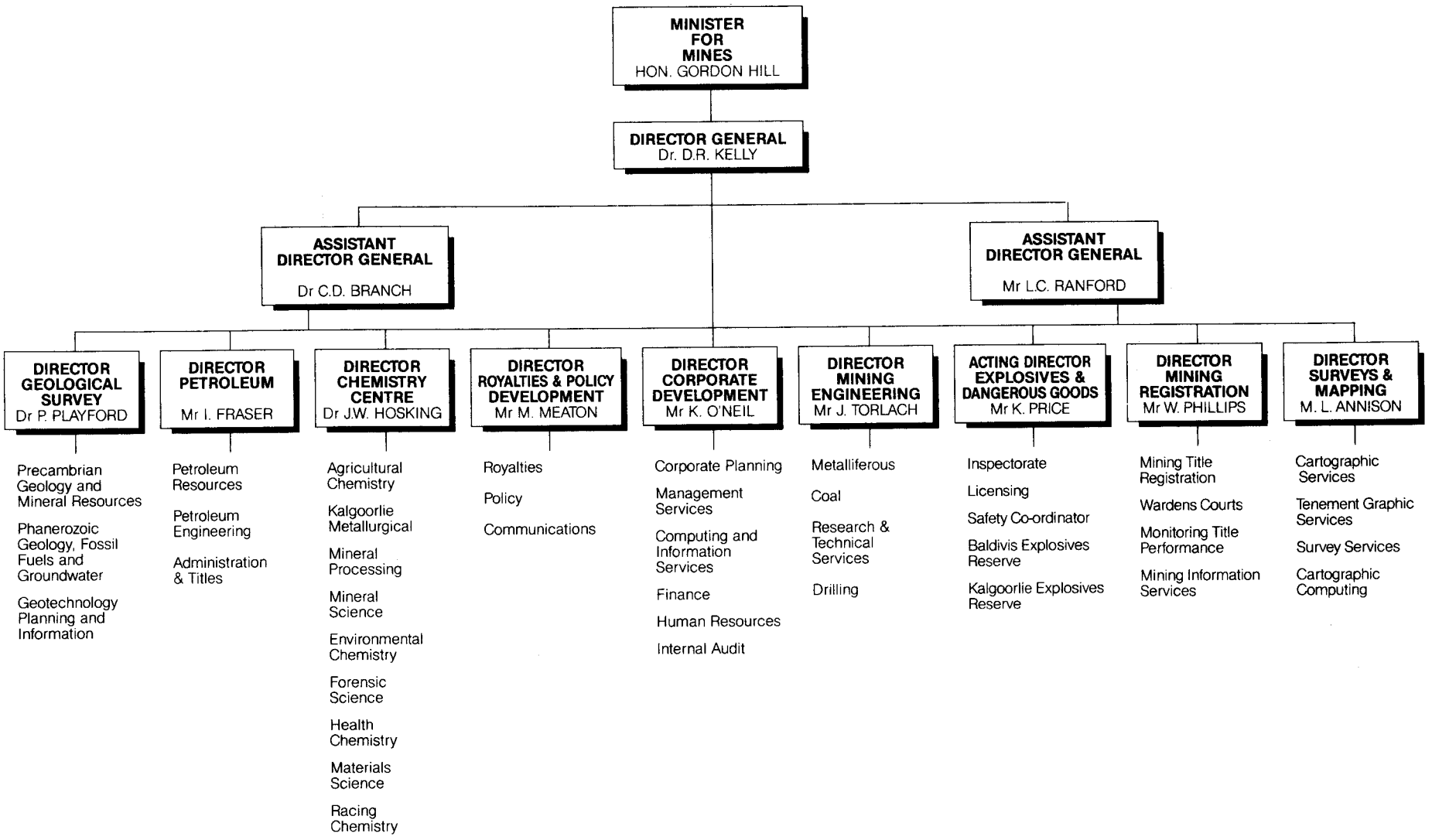
Mr K.O. O'Neil,MBA,CPA, Dip Pub Admin.
DIRECTOR,
CORPORATE DEVELOPMENT DIVISION

Mr J.M. Torlach, BE(Min), MAusIMM.
DIRECTOR,
MINING ENGINEERING DIVISION

Mr K.R. Price, BSc(Hons), ARACI, Grad Dip Admin.
ACTING DIRECTOR,
EXPLOSIVES AND DANGEROUS GOODS DIVISION

Mr W. Phillips, Dip Pub Admin.
DIRECTOR,
MINING REGISTRATION DIVISION

Mr L. Annison, L.S.
DIRECTOR,
SURVEYS AND MAPPING DIVISION


MINISTER FOR MINES
HON. GORDON HILL
DIRECTOR GENERAL
Dr. D.R. KELLY
ASSISTANT DIRECTOR GENERAL
Dr C.D. BRANCH
ASSISTANT DIRECTOR GENERAL
Mr L.C. RANFORD
DIRECTOR GEOLOGICAL SURVEY
Dr P. PLAYFORD
Precambrian Geology and Mineral Resources
Phanerozoic Geology, Fossil Fuels and Groundwater
Geotechnology Planning and Information
DIRECTOR PETROLEUM
Mr I. FRASER
Petroleum Resources
Petroleum Engineering
Administration & Titles
DIRECTOR CHEMISTRY CENTRE
Dr J.W. HOSKING
Agricultural Chemistry
Kalgoorlie Metallurgical
Mineral Processing
Mineral Science
Environmental Chemistry
Forensic Science
Health Chemistry
Materials Science
Racing Chemistry
DIRECTOR ROYALTIES & POLICY DEVELOPMENT
Mr M. MEATON
Royalties
Policy
Communications
DIRECTOR CORPORATE DEVELOPMENT
Mr K. O'NEIL
Corporate Planning
Management Services
Computing and Information Services
Finance
Human Resources
Internal Audit
DIRECTOR MINING ENGINEERING
Mr J. TORLACH
Metalliferous
Coal
Research & Technical Services
Drilling
ACTING DIRECTOR EXPLOSIVES & DANGEROUS GOODS
Mr K. PRICE
Inspectorate
Licensing
Safety Co-ordinator
Baldivis Explosives Reserve
Kalgoorlie Explosives Reserve
DIRECTOR MINING REGISTRATION
Mr W. PHILLIPS
Mining Title Registration
Wardens Courts
Monitoring Title Performance
Mining Information Services
DIRECTOR SURVEYS & MAPPING
M. L. ANNISON
Cartographic Services
Tenement Graphic Services
Survey Services
Cartographic Computing

Divisions of the Department

The Department of Mines is structured into nine divisions which represent homogeneous centres of professional excellence in a diverse organisation.

Activities of the divisions are targetted at achieving the objectives of seven corporate programs. The matrix at pages 22, 23 shows the divisions and the programs into which they have input.

The Geological Survey Division systematically records and interprets the geology of the State and provides this information to Government, industry and the general public in order to assist the exploration, development and conservation of the State's mineral, petroleum and groundwater resources.

It evaluates mineral and petroleum resources as a basis for decision-making by Government and assists and advises on a variety of community needs, including urban planning, land-use matters and engineering developments.

The Petroleum Division facilitates the undertaking by industry of geophysical and drilling programs for the identification and exploitation of oil and gas accumulations. It ensures that sound engineering principles and standards are applied to the design and construction of exploration and production facilities and that safety management systems are in place to secure the occupational health, safety and welfare of the workforce. It also maintains an effective title allocation and registration system, and monitors, advises and interprets State and Commonwealth petroleum legislation.

The Chemistry Centre (WA) provides chemical, mineralogical, metallurgical and associated analytical, investigative and advisory services to Government, industry and the public in the following areas: the development of the State's mineral, water and agricultural resources; monitoring and improving public and occupational health, environmental and material standards within the community; and scientific support to law enforcement and racing agencies.

The Royalties and Policy Development Division develops mineral and petroleum royalty systems which are fair and equitable and administers the collection and audit of royalties paid on behalf of the State and Commonwealth. It also provides economic advice on mining and petroleum industry issues, collects and disseminates statistics and assists in the development and co-ordination of general Departmental policies. The division informs staff, industry and the public about the role of the Department and the importance of the mining and petroleum industry.

The Corporate Development Division provides corporate services for the Corporate Executive and the divisions of the Department whilst responding to the requirements of Government and central agencies. These services include corporate planning, building and purchasing services, computing, typing, records, telecommunications, finance, human resource and auditing activities.

The Mining Engineering Division administers mine safety legislation to safeguard and promote the health and safety of those working in the industry. It provides advice to the Government and to industry on mining engineering matters including deep mining, open-cut mining, quarrying, drilling, the environment and rehabilitation. It monitors exploration safety and administers contract drilling for the Department.

The Explosives and Dangerous Goods Division reviews, formulates and administers laws, regulations and policies aimed at the safe manufacture, storage, handling and transport of explosives and dangerous goods. It provides safety advice on these matters and major hazard control.

The Mining Registration Division receives applications and allocates titles that give legal rights to explore for and mine minerals in Western Australia pursuant to the Mining Act. It maintains a mining tenement registry which records tenement holders, conditions and term of the grant and expenditure details from which the division monitors compliance with the provisions of the Mining Act.

The Surveys and Mapping Division determines, documents and validates the boundaries of tenements and produces and updates all maps and plans necessary for the operations of the Department. All functions from primary field surveys to final map production are embraced. The range of cartographic activities includes charting, field surveying, computations, mapping reprographics, and maintenance of archival materials as an integral part of the tenement management process.

The officers of the Department are mostly located in Perth, although five divisions — Geological Survey, Mining Engineering, Chemistry Centre, Explosives and Dangerous Goods, and Mining Registration — have staff situated in regional centres. Most of these people work in areas that are large and remote by world standards (Figure 7).

In addition to providing services for land-based operations, the Department is also required to administer State and Commonwealth legislation covering offshore oil and gas exploration, exploitation, pipeline transportation and royalty payments.

A Department directory listing all offices is included in the Appendices.

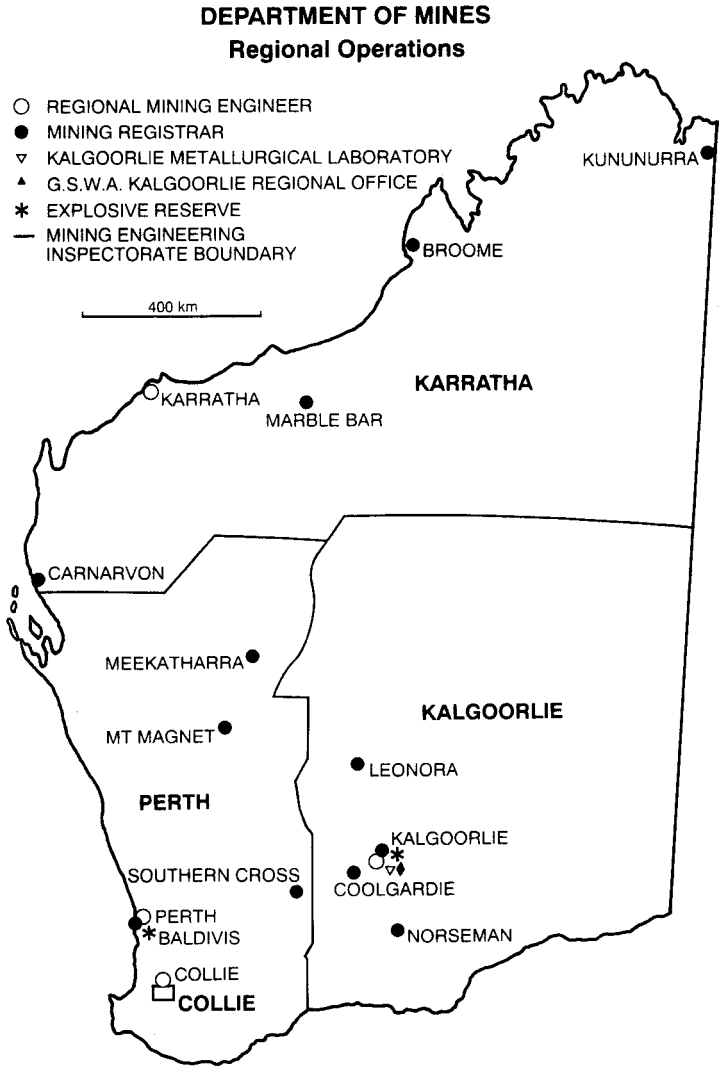


Figure 7

DIVISIONAL ACTIVITIES TO MEET CORPORATE PROGRAMS 1990-91

PROGRAM	SUB-PROGRAM	GEOLOGICAL SURVEY	MINING ENGINEERING	PETROLEUM
MINERALS & PETROLEUM TITLES **1** To ensure that exploration and development titles for minerals and petroleum are issued fairly and without delay.	1.1 Provide an equitable system for granting exploration and development titles as a basis for petroleum and mineral assessment and production.	Provide technical advice in relation to administration of Petroleum and Mining Acts.		Award, maintain and monitor rights to explore and develop petroleum onshore and offshore.
	1.2 Minimise potential for disputes over exploration and development titles and facilitate the prompt settlement of disputes when they do arise.	Technical advice or tenement matters.	Technical advice on tenement matters.	Process dealings, assess fees and advise on legislation.
EXPLORATION & DEVELOPMENT OF NATURAL RESOURCES **2** To foster and assist responsible mineral and petroleum exploration and development, groundwater assessment, and landuse planning, by providing high-quality scientific and technical services and advice to industry, Government and the public.	2.1 Meet the need for geoscientific mapping, research, and resource assessment required to produce up-to-date maps, reports and advice on the geology of the State and its mineral, petroleum, and groundwater resources.	Obtain, interpret and evaluate data on all aspects of geoscience and earth-based resources (mapping, data, collation, evaluation).	Administer contract drilling to support resource assessment.	Provide technical and advisory services to ensure efficient and effective oil-field practice in exploratory and development drilling, testing and production.
	2.2 Provide mineral and metallurgical analytical and research services.			
	2.3 Provide timely dissemination of scientific and technical data from company exploration activities and Departmental studies.	Publish information and maintain geoscientific databases.	Publish reports and guidelines.	Provide information and statistics on petroleum exploration and development.
	2.4 Meet the need for geotechnical, geoenvironmental, hydrogeological, and mining engineering advice and services.	Provide advice and prepare special maps.	Ensure that effective mining engineering advice is available as required.	Advise on oil and gas volumes, field behaviour and production techniques to ensure optimum production and conservation of resources.
	2.5 Foster a favourable climate in the community for mineral and petroleum exploration and development.	Inform and advise Minister, and liaise with industry, Aboriginal and other community groups.	Ensure mineral exploration and mining operations meet community standards.	Develop strategies to encourage a strong and active oil and gas industry.
ENVIRONMENTAL PROTECTION & REHABILITATION **3** To ensure that proper attention is given to the protection and rehabilitation of the natural environment as it may be affected by mineral and petroleum exploration and development, and to facilitate the protection of groundwater resources.	• Ensure protection and rehabilitation of the natural environment as it may be affected by mineral and petroleum exploration and development.	Review and advise on environmental and/or rehabilitation aspects of exploration and mining proposals.	Ensure protection and rehabilitation of the environment as it may be affected by mineral exploration and development.	Implement audit procedures to ensure industry commitment and compliance with environmental requirements.
	• Facilitate the protection and rehabilitation of groundwater resources.	Provide hydrogeological advice on groundwater contamination.	Ensure drilling and tailings dams are managed to minimise groundwater contamination.	Ensure oil drilling operations do not pollute underground water resources.
	• Provide chemical services for environmental management.			
	• Provide geology and mineral resource information and advice for planning and management of National Parks and conservation reserves.	Provide geoscientific advice for landuse planning.		Advise on petroleum prospectivity and possible development methods for environmentally sensitive areas.
COMMUNITY BENEFITS **4** To ensure that the community receives a fair return from the extraction of the State's mineral and petroleum resources.	• Ensure that royalty collection is carried out in an economically and administratively efficient manner.	Provide geological advice to assist royalty determination.	Inspect mineral projects to assist with royalty determination and collection.	Ensure standards are met for oil and gas metering systems, and for the measurement of petroleum quantity and composition.
WORKERS & PUBLIC SAFETY **5** To ensure that all operations in the mining and petroleum industries, and activities involving explosives and dangerous goods, are conducted in a manner that is safe for workers and the public.	5.1 Maximise the safety and health of workers in the mineral and petroleum industries.	Provide geotechnical advice relating to mine safety.	Ensure compliance with the Act and Regulations by regular inspections, training and advice in mineral exploration and metalliferous and coal mines.	Carry out audits and safety inspections of petroleum operations; provide technical advice on exploration and development proposals and plant modifications.
	5.2 Minimise hazards to the public from activities involving explosives and dangerous goods.		Ensure public safety at abandoned mines.	Ensure the design, installation and operations of licenced petroleum pipelines comply with approved safety standards.
CHEMICAL SERVICES **6** To enhance agricultural and industrial development, and the protection of community, consumer, environmental and health standards, by providing high-quality independent chemical services to Government, industry and the public.	• Agricultural chemistry services; • Forensic science services; • Environmental chemistry services; • Public and occupational health chemistry services; • Materials and consumer protection scientific services; • Racing chemistry services.			

CHEMISTRY CENTRE W.A.	EXPLOSIVES & DANGEROUS GOODS	MINING REGISTRATION	SURVEYS & MAPPING	ROYALTIES & POLICY DEVELOPMENT
		Award, maintain and monitor rights to explore and mine minerals onshore and offshore.	Provide and maintain maps depicting all mining and petroleum tenure and other land tenure; provide public searching facilities; record and certify position and other land tenure status of tenements; and manage surveying operations to establish tenement boundaries.	
		Operate Warden's Court and process Ministerial Appeals, Monitor effectiveness of legislation.	Provide a means of resolving conflict arising in respect to tenement boundaries, positions or markings.	
Provide chemical, mineralogical, analytical and advisory services on minerals and water.		Monitor performance of tenement holders in the submission of geoscientific reports.	Provide supporting geographical information systems.	
Provide chemical, extractive metallurgical and mineral processing advisory services and undertake investigations to enhance the processing of minerals.				
		Record and publish tenement data for industry.	Provide a cartographic and map preparation facility.	
Provide analytical and advisory services on groundwater, ores, mining and mineral processing.			Provide a cartographic and map preparation facility.	
Develop and monitor new technology appropriate to further processing of minerals.		Liaise with industry.		Inform Government and community.
Inspect, investigate and advise on environmentally sensitive areas, including mine wastes.		Issue and monitor titles with due regard to protection and rehabilitation of the environment.	Provide a graphical index and record of environmental themes.	
Provide chemical advice on the protection and rehabilitation of groundwater.	Ensure that dangerous goods are transported in a manner that provides maximum protection to the environment.			
Analyse and identify contaminants and natural constituents in air and water. Provide soil testing services for soil conservation projects.				
Provide chemical and mineralogical analytical services on geological materials.			Monitor changes to Environmental Reserve boundaries and maintain graphical systems.	
			Support the site location data base.	Collection of royalties and statistics.
Inspect, test, investigate and advise on occupational health matters.			Provide a repository for information concerning plans of mines and minesites.	
Inspect, test, investigate and advise on chemical aspects of dangerous goods, handling, storage and transport.	Provide a high level of assurance of public safety at places where explosives and dangerous goods are manufactured, stored or transported.			
Undertake investigations, solve problems and provide scientific support, for agricultural research and regulatory programs; for law enforcement and drug free racing; for protection of community health, consumer and environment standards, and for the support of chemical industry.				**CORPORATE SERVICES** **7** To ensure that the human, financial and other resources of the Department are used efficiently and effectively to provide a service responsive to the needs of the community, industry and Government. (Affects all programs.)

PROGRAM 1: Minerals & Petroleum Titles

To ensure that exploration and development titles for minerals and petroleum are issued fairly and without delay.

Through this program the Department seeks to provide an equitable system for granting secure exploration and development titles as a basis for petroleum and mineral assessment and production. Concurrent with this goal is the aim of minimising the potential for disputes over exploration and development titles and facilitating the prompt settlement of disputes when they do arise.

Need for Secure Title

The capital intensive nature of the mining and petroleum industries makes it imperative that where exploration leads to the initiation and development of a project, explorers must have secure tenure. The ground-rules for access to land and security of tenure are embodied in mining and petroleum legislation from the West Australian Parliament. This legislation not only protects the rights of the title holder but also the rights of the community. The various Acts require that holders of exploration or mining titles meet certain commitments to retain these rights.

The framework under which the Department operates is aimed at protecting the rights of all parties (from the large corporation to the small individual), as well as providing a fair and reasonable return to the community for the rights given to carry out mining operations and to see that such operations are carried out in harmony with other land-use.

An on-going review of legislation, procedures and policies is being undertaken to ensure that registration of titles and tenement matters are effected with efficiency and within acceptable time-frames.

Mining Tenements

The Department has identified the following key elements for an efficient, fair and equitable mining tenements title system:

- The principle of "first received — first considered";
- Security of tenure for holders of titles;
- Dispute settlement procedures and appeal rights;
- Electronically assisted processing of tenement applications; and
- An electronic mining tenement register and public plan.

The program is undertaken through the operation of a title registration and dispute settlement system. A variety of permits and titles is issued through Perth and eleven regional offices. The various "rights" for exploration and development include miners rights, exploration permits, mineral leases, general purpose leases, production licenses and pipeline licenses.

The prime responsibility for the issue of these rights, their registration, transfers and other dealings rests with the Mining Registration and Petroleum divisions. They are assisted by the Surveys and Mapping Division which provides plans of the titles.

Both the Geological Survey and Mining Engineering divisions provide technical advice needed to formulate conditions for mining tenements. They also monitor titles for compliance with statutory obligations. Field inspections are sometimes a requirement of these functions. The Geological Survey Division provides ongoing advice on geoscientific and geotechnical matters relevant to the administration and regulation of proposed exploration programs and mining projects.

In addition to the Head Office in Perth, Mining Registrars' offices are maintained at eleven regional centres throughout the State. These offices accept applications and dealings and provide access to public plans and other Department services.

A Warden's Court system operates to deal with disputes, complemented by both legal and administrative appeal rights. As well as the Warden's Court in Perth, Wardens sit on a regular basis in courts located throughout the State in the regional Mining Registrars'

offices ensuring that customers located in these areas have ready access to Warden's Court services.

Mining Tenement Activity

During the year a total of 4 989 applications for mining titles were received and there were 14 847 mining titles covering 20 472 168 hectares in force at 30 June 1991.

The number of mining titles in force over the last three years has been as follows:

Tenement Type	1989	1990	1991
Prospecting Licence	11 919	7 725	5 517
Exploration Licence	2 630	2 264	2 183
Mining Leases & Other	6 636	6 953	6 728

In November 1990 the Government released its "Resolution of Conflict" policy for National Parks. Work subsequently commenced to determine a number of outstanding applications in respect of National Parks and Conservation Reserves.

Dealings such as transfers and caveats involving changes to title ownership totalled 14 620 for the year, which represents a 13% increase on the 12 988 lodged in the previous year. The number of applications for exemption from work commitments dropped to 2 744 after the all-time high of over 3 300 in 1989-90.

A total 962 mining tenements were forfeited for non-payment of rental or breach of condition.

Customer Service — Mining

Following a downturn in some title related functions, a review of the staffing requirements of the Mining Registration Division was conducted during the year. A 5% reduction in Head Office staff numbers was made without affecting the level of service at the Mining Information Centre or in other areas of customer contact. The staffing at regional offices is also to be reduced as part of Departmental rationalisation.

Development of the Department's computerised mining tenement index system, TENDEX, continued. The computerised recording of rental payments, expenditure reporting and exemptions for all live mining tenements was completed during the year. During 1991-92 a subsystem (known as TRAX) will be progressively made accessible at the various regional offices, commencing with Kalgoorlie.

Petroleum Tenement Activity

At 30 June 1991 there were 139 current petroleum titles in Western Australia — comprising 96 exploration permits, 22 production licences and 21 pipeline licences.

To promote exploration and increase the accessibility of exploration acreage, during the year the Department announced a new strategy to allow the whole onshore area of the State to be advertised as available for permitting. As part of this new policy all vacant areas are gazetted as available on a quarterly basis with a three-month period as a closing date for new applications.

This State-wide release will make acreage more readily available and make it easier for companies to develop and implement their exploration strategies. The inclusion of regular closing dates will avoid the confusion and administrative difficulty associated with the old over-the-counter system.

The first releases under this system have resulted in seven applications for permits in the Canning and Carnarvon basins.

Another new initiative during the year was the introduction of Drilling Reservations which are aimed at the smaller companies, who can now acquire exploration acreage without the encumberance of a five-year financial commitment required by a conventional exploration permit.

The Drilling Reservations allow explorers to drill individual prospects and provide a 12-month tenure to a relatively small area. This tenure carries an obligation to drill one well.

The new initiatives should help all explorers, and in particular the small companies. Speculative geophysical surveys will also be encouraged and it is hoped this will lead to more discoveries.

During the year 27 offshore areas were advertised and eight new offshore permits were granted. These included two new permits in the offshore Perth Basin, an area which has not seen exploration for nearly ten years. A further six new Perth Basin permit applications

are currently under offer so that almost all the offshore part of this basin will be under permit again within a short time.

In 1990-91 nine permits were surrendered, four were cancelled and one expired, which was a similar rate to that for 1989-90.

Public Plans and Tenement Maps

This year 4 166 public plans were maintained by the Survey and Mapping Division to chart all mineral tenements throughout the State.

For the year, 4 949 mining tenement applications were recorded, plotted and appraised for land tenure status. In addition, 8 065 mining tenements were cancelled from public plans.

All Petroleum tenement maps and plans were fully maintained and quarterly editions of the State petroleum map and booklet were produced and released on schedule.

Tenement Graphics

TENGRAPH is a major system under development which will provide a computer-based graphical display of mining tenement information, together with other land information. It will be the corporate graphical database and will interface with other textural databases such as the mining tenement index system TENDEX.

TENGRAPH will be an electronic public plan which, when fully implemented, will replace current public plans. This is a major project as there are currently 4 166 plans being maintained in the public plan system covering the State. The system will dramatically improve efficiency and effectiveness by eliminating duplication in public plan production, and maintenance and in the processing of mining tenement applications.

TENGRAPH'S implementation will be phased commencing in the Eastern Goldfields region which includes about 50% of the current mining tenements in the State. It will then expand in a cellular approach to eventually cover the entire State. The system will provide new products in terms of digital data usable throughout the whole of Government plus additional services to the mining industry.

Surveys of Tenements

A total of 233 mining tenements were surveyed during the year.

There remains a backlog of 3 022 leases requiring survey excluding 51 coal mining leases, 102 mineral leases, and 10 tailing leases.

The survey vote was fully committed by the third quarter of the financial year. Surveys proceeded with the Department coordinating the preparation and issue of instructions to approved contract surveyors.

The Hill River/Mt Lesueur project (34 tenements) was surveyed using the Global Positioning System (GPS) which fixes positions on the earth's surface by the use of satellites. This was the first use of this technology for tenement surveying.

New Technology

To assist in the survey of tenements and their recording the Department investigated and utilised new technological approaches.

Digital data on the Eastern Goldfields region was recorded using survey data integration (SDI), while three global positioning systems (GPS) were purchased to assist Department activities requiring accurate ground location. A pilot project to evaluate GPS was undertaken at Kalgoorlie in association with the Department of Land Administration (DOLA).

During the year a software package initiated by DOLA was tested to improve the mathematical validation of survey document dimensions. The program was subsequently implemented and staff training commenced.

The Mining Act has been amended to reflect the Department's commitment to the preparation of all survey documents. Part of the software will be utilised in the preparation of the tenement title (Instrument of Lease) in conjunction with the Mining Registration Division's proposed Electronic Register.

Microfilm Program

Microfilming of original maps and documents continued, with the following work completed in the year:

- Survey Diagrams — approximately 75% have been microfilmed in black and white;

- 1904 Act Registers — filming was completed;
- Field Books — all from 'A' to 'E' were microfilmed; and
- Public plans — the typing and jacketting of microfilm continued.

Graticular Sections

A Graticular Sections Implementation Committee, comprising officers from the Surveys and Mapping and Mining Registration divisions, drew up procedures to ensure a smooth introduction of the graticular sections system for exploration licences. The following papers were produced:

- Procedural Paper "Graticular Exploration Licences" for internal use; and
- Information Pamphlet "Exploration Licences Graticular Boundary System" for internal and external use.

Mining industry seminars were held by Surveys and Mapping and Mining Registration division officers in Perth and Kalgoorlie.

A total of 215 new graticular section overlay maps were produced to facilitate the use of the new system.

The Department now has full coverage of graticular section plans at all required scales, including indexes. Mining Registrars have full coverage within their jurisdiction.

Petroleum tenements have been operating under a graticular system since 1967.

Mining Industry Liaison

Five meetings of the Mining Industry Liaison Committee (MILC) were held during the year.

Topics covered at these meetings included:

- Implementation of an exploration retention licence tenement;
- Formation of a sub-committee to look at the general issue of exploration information, and specific issues of:

  data from open range exploration

  acquisition of regional exploration data

  copyright relating to reporting and exploration data.
- Road verge drilling and the approval procedures necessary;
- Options for storage of drill core;
- The formulation of standard conditions for mining tenements; and
- The current extent and future spread of dieback caused by fungi of the genus phytophthera.

Advice on these matters was forwarded to the Minister where appropriate.

PROGRAM 2: Exploration & Development of Natural Resources

To foster and assist responsible mineral and petroleum exploration and development, groundwater assessment, and land-use planning, by providing high-quality scientific and technical services and advice to industry, Government and the public.

The discovery and development of WA's mineral, fossil fuel and groundwater resources is intrinsic to the State's development. This principle is the cornerstone of the Department's second program with specific activities aimed at the provision of scientific advice to Government and the public on medium and long-term planning and decision-making, particularly in relation to the mining and petroleum industry, engineering and urban development.

Decisions regarding development of any mineral or fossil fuel resource should be made on the best scientific information and advice available. The Department of Mines is the central location for geoscientific information which is provided by mining and petroleum companies, various research organisations and institutions, plus field and office studies by the Department's own geoscientists.

The addition of mineral and metallurgical analytical services creates a highly-efficient and comprehensive scientific base for the successful exploration and development of the State's natural resources.

Divisional Roles

Seven divisions of the Department support this program. The Geological Survey Division carries out geoscientific mapping and research, and provides advice relating to mineral, fossil fuel and groundwater resources within the State.

The Mining Engineering Division's newly-formed Exploration, Safety and Drilling Branch has responsibility for inspection of mineral exploration and drilling operations and the supervision of contract drilling.

The Petroleum Division is responsible for fostering petroleum exploration, drilling, engineering, oil and gas production and pipeline transportation.

The Surveys and Mapping Division provides cartographic, mapping and land information services whilst Mining Registration monitors the performance of tenement holders in the submission of geoscientific reports.

The Chemistry Centre provides scientific support and assists in the assessment and development of mineral processing while the Royalties and Policy Development Division co-ordinates the preparation of Departmental policies and provides economic advice to the government and community.

The integration of this geoscientific knowledge began more than 100 years ago. Since then the material compiled from all sources, including the Department's own field investigations, has proven to be of significant benefit to the whole community.

Geological Survey Liaison Committee

The Geological Survey Liaison Committee, established by the Minister for Mines in October 1988, brings together the interests of industry and research institutions to ensure Geological Survey work meets their most appropriate needs.

Two sub-committees have been established: one to meet the special needs of the Goldfields region; and the other to consider the requirements of hydrogeology in the State.

General Geological Mapping

Progress achieved in documenting geoscientific information about the State is shown in Figure 8. This figure displays the areas where data from Departmental studies have been integrated with information from mineral and petroleum exploration companies by the Geological Survey, reports written, and these data transformed by the Surveys and Mapping Division into printed maps available to the public. Some mapping

MAPS AND EXPLANATORY NOTES PUBLISHED IN 1990/91

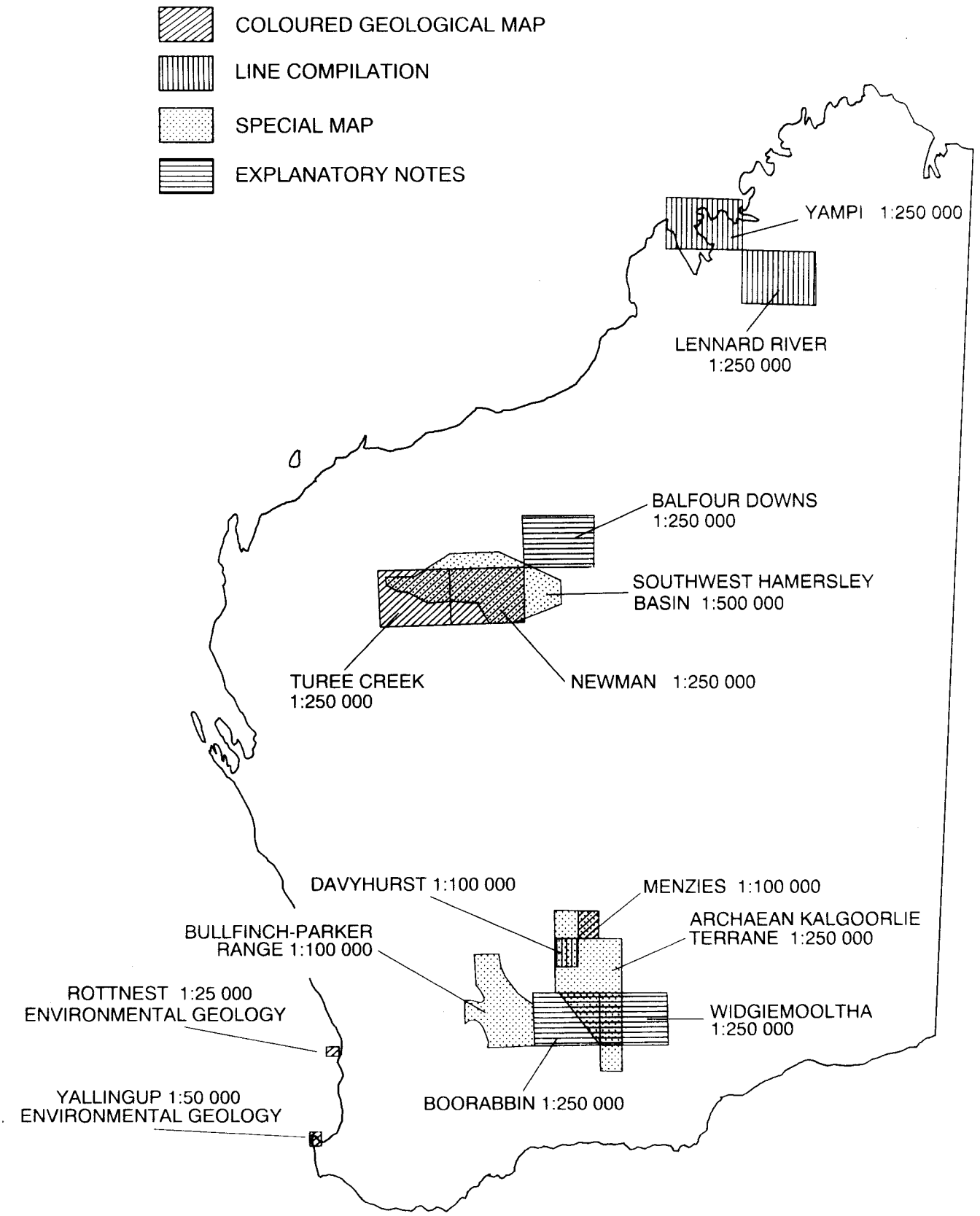


Figure 8

was carried out with the Bureau of Mineral Resources (BMR) under the National Geoscience Mapping Accord (NGMA).

Figure 8, moreover, reflects Government policy that, in order to maximise the exploration effort by industry for the State's minerals, an up-to-date synthesis of geoscientific data at an appropriate scale should be available for those areas of current or anticipated exploration interest.

It is clear from Figure 8 that the intensity of information aggregated in reports and maps ranges from various degrees of regional synthesis (1:1 000 000, 1:500 000, 1:250 000 scales) to detailed analysis (1:100 000, 1:50 000, 1:25 000 scales). This results from an appreciation by the Department of industry's and Government's needs for the necessary degree of detail, as provided by the interchange of ideas through the Geological Survey Liaison Committee.

The way in which this geoscientific information is translated into map form suitable for the public, prospectors and industry is determined mainly by the Surveys and Mapping Division. Most maps in 1990-91 were produced by traditional means, and the products have been acclaimed by industry for the excellence of presentation and detail.

However this year preparation of the Cheritons Find map has taken advantage of computer-based drafting. For the map, field compilations were digitised and an electrostatic four-colour paper copy produced as a proof. Confirmation of map data will be followed by the generation of final plate negatives and conventional printing.

This trial has successfully demonstrated the potential for a substantial reduction in costs and labour in the map production stages against conventional colour separation techniques. A further advantage is the availability of digital data and its flexibility for manipulation.

Mineralisation Studies

Final reviews were completed of a report on bauxite mineralisation in the Darling Range, and a report tabulating platinum and gold analyses from samples collected from various layered complexes around the State was produced.

As part of a study on gold mineralisation in the Eastern Goldfields, field investigations during the period were largely completed in the Leonora-Niagara and Menzies-Kambalda belts. The draft report on the latter area is being revised.

Work continues on the compilation of an updated version of the heavy mineral sands bulletin, with significant input from this work into a North Perth Basin mineral potential study of the System 5 proposed conservation areas.

A study of high grade silica resources continues; while a draft of a gypsum bulletin reviewing deposits of the sand coastal belt as far as Lake MacLeod has been completed.

Field work and data compilation has commenced for a review of the mineral occurrences of the Albany area.

Basin Studies

A geophysical study of the southern Perth Basin was completed, as was geological mapping of the Arrowsmith and Hill River sheets. New projects commenced included a comprehensive review of the geology and geophysics of the northern Perth Basin, and a study of Jurassic sequences in the southern North West Shelf.

Geophysical mapping of the subsurface of Phanerozoic basins continued. A series of 1:250 000 scale seismic structure maps at various horizons was completed for the onshore and offshore portions of the Canning Basin. Sheets showing seismic structure onshore at base Grant Group have been published at this scale and at 1:1 000 000, and are available on floppy disks. In addition, a 1:1 000 000 map showing the Pre-Grant Group geology has also been published. A number of seismic structure contour maps in the southern Carnarvon Basin were also published.

Seismic mapping of the Chinook, Scindian, Griffin and Ramillies oilfields in the offshore Carnarvon Basin was undertaken to assist the Petroleum Division in estimating petroleum reserves.

Geological advice was provided on the Hill River and Collie coalfields. The geological study of the Collie Coalfield is nearing completion, with the production of computer-generated structural cross-sections.

A preliminary report was written on the Quaternary palynology of Barker Swamp, Rottnest Island, and a joint paper on the stratigraphy of the Glengarry Group, Nabberu Basin was prepared.

Hydrogeology

With the closure of the Drilling Branch, future drilling for groundwater resources assessment will be carried out by contractors. From July 1990 to the time of closure in October that year, 53 bores had been drilled with an aggregate depth of 6 013m.

Deep drilling was carried out at Karridale Line 6 bore, which was drilled to 1 605m, completing the drilling of a line of deep bores in the southern Perth Basin. The results further confirmed the existence of very large fresh groundwater resources in this region.

The Leeman and Scott coastal plain drilling programs were commenced and work was subsequently suspended prior to completion. In the Leeman project 37 bores with an aggregate depth of 2 452m were drilled at 18 sites. The work disclosed the presence of larger fresh groundwater resources than anticipated. In the Scott Coastal Plain project 15 bores with an aggregate depth of 1 955m were drilled at five sites. The drilling extended the known extent of the fresh groundwater resources in the southern Perth Basin and provided valuable information on intake and recharge areas.

Assessment of results and preparation of reports on the groundwater resources of the Eastern Goldfields (Roe Palaeodrainage) and Collie Basin were completed.

Preparation of the draft of the Derby hydrogeological map and explanatory notes was completed. Compilation and preparation of explanatory notes for the Kalgoorlie, Kurnalpi, Widgiemooltha and Boorabbin hydrogeological maps in the Eastern Goldfields has also progressed steadily.

Work was carried out for the Water Authority supervising and assessing results of drilling for Carnarvon, Exmouth, Horrocks Beach, New Norcia, Halls Creek, Piawanning, Watheroo, and Leonora town water supplies.

Assistance was given to the Department of Agriculture in a drought relief drilling program in the Kimberley district. Bore sites were selected, and drilling supervised, on eight stations in November 1990. The stations were located in very difficult areas for groundwater resources and only seven successful bores (25% success rate) were completed.

Geological Studies for Land-use Planning

Fieldwork was completed for a review of the geology and mineral potential of the Hamersley Range National Park, and preliminary fieldwork was carried out as part of an assessment of the Dundas Nature Reserve. The geoscientific evaluation of a large number of proposed Conservation Reserves was undertaken. Advice on a variety of issues was provided to the Department of Planning and Urban Development.

Engineering Geology

Geotechnical advice was provided to the Water Authority, Westrail, and the Main Roads Department. Geotechnical and rock mechanics advice has been provided to the Mines Inspectorate on open pit and underground mine safety. Cooperative research programs with industry, University of WA and Curtin University have also been instigated to address aspects of mine safety. Advice given to the Water Authority and Main Roads Department includes construction of the new Victoria Dam; investigations of potential damsites at North Dandalup, Margaret River, Manjimup, and Conjurunup; and quarry sites in the Murchison and Norseman areas.

Ground investigation was carried out in the Meckering area after the earthquake in January 1990. The results were reported in the Record series.

Seismic refraction surveys were conducted for the Water Authority at the proposed Conjurunup damsite and further seismic work was done at the North Dandalup damsite. A seismic refraction survey for the Main Roads Department was completed at proposed road cuts along the Brookton Highway. Interpretation of the North Dandalup damsite seismic refraction survey was completed.

Geoscientific Databases

The Geological Survey maintains a number of geoscientific databases, and work continued on updating WAMEX (mineral exploration data), WAPEX (petroleum exploration data), MININFORM (mineral resources and reserves data), ROCKMIN (petrological data), and the geophysical and hydrogeological databases. A review of ROCKMIN is being undertaken to enable it to be expanded to cater for the storage and manipulation of associated geochemical data.

During the year 2 766 mineral exploration and 675 petroleum exploration reports were received. The number of reports made available to the public on microfiche was 1 898.

In the Museum, several educational and historical displays were prepared, school visits were catered for, and rock and mineral sample sets were supplied to schools.

During the period under review there were 5 132 visitors to the library of whom 1 590 used the microform reading and printing facilities. Staff loans totalled 791 and a total of 634 inter-library loans were arranged. Items sent to the other libraries on inter-library loan totalled 146.

Extensive public use of microfiche indexes to the mineral and petroleum exploration open-file reports continued, and there were 85 on-line searches of the WAMEX database and 16 searches of the WAPEX database.

Editing and Publishing Services

Numerous enquiries on a wide range of topics were dealt with during the year. Areas covered included information and assistance for prospectors, urban geology for land-owners, mining and its environmental implications, and educational geology for teachers and students.

A second computer-aided design unit was installed in the Surveys and Mapping Division. Such facilities have halved typesetting costs by using a self-typing method and an image processor. The primary CAD workstation has evolved into a publication tool of the future and with a little more development will almost certainly replace many of the traditional drafting procedures.

A total of 1 800 figures, diagrams, slides and overheads was produced in response to the needs of all divisions. The demand for graphic material for publication needed staff secondment to meet peaks throughout the year.

A total of 73 publications were released during the year; 54 of these were maps. One publication deserves special mention. "Memoir 3 — Geology and Mineral Resources of Western Australia", represents the culmination of 15 years' work by the Geological Survey Division. More than 600 copies had been sold by 30 June 1991. It is expected that the Memoir and the three maps that accompany it will be standard reference works for many years to come.

Information Sales

The geoscientific data made available by the Geological Survey Division on microfilm and microfiche, together with its maps and publications, provide a valuable information base for industry and contribute towards maintaining a favourable climate for exploration. The value of maps and publications sold amounted to $162 766 while microfilm and microfiche sales realised $102 684.

Consultation and Advice

The demands to provide advice to industry, Government and to the broader community continued to grow. Specifically, geotechnical, hydrogeological, environmental and engineering advice has been accelerated by new technological achievements, expansion in the industry, environmental awareness, health and safety moves by Government, and a range of socio-political factors.

Aboriginal Liaison

Since 1984 an Aboriginal Liaison Officer has materially contributed to the Department's role of ensuring that all Western Australians receive maximum benefit from the exploration and development of minerals and petroleum.

The officer conducts workshops and provides advice to Aboriginal communities, to exploration and mining companies and to Government. The acute awareness by Aboriginal communities of the potential effects of exploration and mining upon their physical and social environment has resulted in the Aboriginal

Liaison Officer being in continuous demand for both advice and as a negotiator between the various parties. The officer also undertakes policy reviews regarding land access and land-use.

Aboriginal communities and mining and petoleum companies have drawn on these services over recent years, many on an on-going basis.

Integrated Land Information

The Surveys and Mapping Division participated in a pilot study for the use of notional charges as a result of the Integrated Land Information Program taskforce recommendations.

The North Perth Basin joint project, initiated in 1989-90 and involving the Mines Department, Environmental Protection Authority and Department of Conservation and Land Management was completed. The Land Information System database was demonstrated to West Australian Land Information System council members and Department of State Development representatives.

A total of 90 computer plots was generated for on-going analysis and evaluation of resources and environmental information.

A Departmental officer skilled in land tenure research is involved in the production of the WALIS Land Information Directory. It is hoped by the use of this directory that the location and availability of land information will become more accessible. Use of online land information access in conjunction with the remote search facility has enabled a more efficient response to clients.

A final report on a pilot study covering the northwestern metropolitan region was completed and released. The report was an important input into the development of a Geographic Information System plan. The plan, proposing future strategies, was approved and is now being implemented.

In addition to the strategic plan, evaluation tests were conducted to find the most suitable hardware to run the GIS software. At the conclusion of the evaluation, an IBM RS/6000 Unix workstation and ARC/INFO software package was purchased and installed.

Preliminary work has commenced on the Hamersley Range GIS project involving the Department of State Development. The study aims to provide a resource strategy for rational, long-term development of the Pilbara iron ore industry and its impact on national park and other land-use strategies. It is expected the project will be completed by 31 October 1991.

Displays and Public Presentations

A Western Australian basins seminar was conducted at which a number of papers on the geology and petroleum potential of several sedimentary basins was presented by Department, Bureau of Mineral Resources and industry speakers. This was arranged to coincide with the very successful Petroleum Technology Australia 1990 Oil and Gas Expo which was held in Perth. The Geological Survey Division also ran field excursions in the Bonaparte and Carnarvon basins for petroleum industry personnel.

Geological Survey Division staff presented several papers at the International Conference on Groundwater in Large Sedimentary Basins and ran successful field excursions for the 3rd International Archaean Symposium held in Perth. The Division also prepared a display for the joint Geological Society of Australia/Society of Exploration Geophysicists conference in Sydney.

Liaison with Petroleum Industry

Close liaison with the petroleum industry was maintained by the Petroleum Division ensuring that the Department had current information on all activities for dissemination and could provide advice to industry and government clients as well as the general public.

Regular meetings were held with operating companies to discuss safety and operational matters, environmental problems, drilling and workover programs and current and future development projects. Companies were also kept abreast of changes in legislative requirements which could affect their operations.

A new Schedule of Onshore Exploration and Production Requirements was completed after extensive discussions with the industry and other interested parties.

Comments have also been received on a new Schedule of Specific Requirements as to Design,

Construction and Operations of Petroleum Pipelines 1991, and these are being reviewed.

Heightened interest in petroleum exploration in the State is indicated by an increase in wells drilled. The number of petroleum discoveries, although slightly reduced from last year, has continued to be encouraging.

All the 33 exploration and 43 development wells drilled were monitored and requests for testing and completion reviewed. This included petrophysical analysis of wireline logs using an in-house program.

All requests for approval of exploration activity were assessed for safety, technical parameters and suitability of evaluation procedures. They were also referred to the relevant agencies for consideration of potential environmental impact.

The Petroleum Division was actively involved in reviewing and monitoring the following new projects:

- Boundary oil field development, located 60 km from Derby, comprising a flowline to an existing production facility at Meda Battery which came onstream in December 1990;
- Yammaderry — this $15 million development comprised a monopod offshore platform, a flowline and a gaslift line linked to the existing facilities on Thevenard Island through the Saladin C platform. Yammaderry came onstream in March 1991; and
- Cowle — a $20 million development, similar to Yammaderry, that came onstream in April 1991.

The division continued to monitor other new developments at Goodwyn, Tubridgi, Cossack, Campbell, Sinbad, Rosette and Beharra Springs.

In addition, the division continued to interact with the industry in relation to the inspection and maintenance of existing platforms, pipelines and production facilities, as well as major upgrades/modifications such as gaslift facilities at Saladin, Chervil, North Herald and South Pepper and remedial stabilisation of the trunkline from the North Rankin 'A' platform to shore.

Petroleum Production

An assessment has been made during the year of the oil and gas reserves for the Saladin, Rosette, Griffin and Chinook fields. Collation of all production data in the State for analysis is continuing.

Petrophysical analyses have been carried out for the Wandoo, Leatherback, Ramillies, Yodel, Scindian and Boundary discoveries.

Scientific Services

The Chemistry Centre utilises its extensive capabilities in the exploration and development of our natural resources by providing mineral science services. Activities range from the analysis and characterisation of minerals and mineral products through mineralogical and metallurgical services to complete process development for new ore deposits.

The Mineral Science Laboratory continued to support the Geological Survey Division in providing more timely analytical reports for its research programs. The Mining Engineering Division was supported with both analytical data and advice on occupational hygiene matters in the mining environment. New equipment acquired by this laboratory included an automated X-ray powder diffractometer and an inductively coupled plasma mass spectrometer (ICP-MS). The latter was purchased with substantial funding from the Research Centre for Advanced Mineral and Materials Processing at the University of WA, in which the Chemistry Centre is a partner.

The Mineral Processing Laboratory continued to provide consulting services and test work facilities to the mining industry. Major pilot kiln runs were conducted on ilmenite upgrading to synthetic rutile, and client work on gold production, including refractory ore treatment and carbon regeneration, was steady. Promising developments for economically treating high copper gold ores resulted from testwork conducted. A Federal grant for developing online gold and cyanide analysers that involves the laboratory with a commercial partner was received and a program commenced.

The Kalgoorlie Metallurgical Laboratory set up and commissioned a small pilot scale column flotation unit, which will be further extended in a Minerals and Energy Research Institute of Western Australia (MERIWA) project involving four industry sponsors. Extensive computer-controlled bubble size measurement tests have enabled better definition of operating conditions. This laboratory continued to provide a rapid umpire quality bullion analysis facility to industry clients.

PROGRAM 3: Environmental Protection & Rehabilitation

To ensure that proper attention is given to the protection and rehabilitation of the natural environment as it may be affected by mineral and petroleum exploration and development, and to facilitate the protection of groundwater resources.

The Department is involved in a diverse range of management, monitoring and consultancy roles concerned with the protection and management of the environment. In addition to the activities which specifically relate to the mining and petroleum sectors, the Chemistry Centre provides a range of analytical and advisory services covering all areas of the environment.

Divisional Roles

Seven divisions play an active role in supporting this program.

The Mining Registration Division places conditions on titles to ensure protection and rehabilitation of the mined areas. These conditions are developed by the Mining Engineering Division in consultation with the Environmental Protection Authority. All new development proposals are assessed and appropriate conditions recommended to ensure adequate environmental management and protection in accordance with Government policies.The Mining Engineering Division coordinates the Department's response to the Environmental Protection Authority for resource projects that are the subject of formal environmental assessments. Monitoring of these projects to ensure compliance is undertaken by the Mining Registration and Mining Engineering divisions. Where illegal mining or breaches of conditions has taken place, these divisions, in concert, may initiate prosecutions.

The Petroleum Division provides advice on environmental matters related to petroleum exploration and development and operates in co-operation with other Government departments and industry.

The Surveys and Mapping Division monitors changes to environmental reserve boundaries and maintains graphical and digital systems to support agencies involved in environmental matters.

The Chemistry Centre assesses reviews and management programs with regard to the impact of mining and industrial development on the environment. Key areas which the Chemistry Centre evaluates include: occupational health considerations of chemical use; stack gas or other process chemical emissions; disposals of waste chemicals or by-products; the use of local water resources; and the effect on the quality of these resources.

The Geological Survey Division undertakes reviews of mineral and petroleum prospectivity in areas proposed as new Conservation Reserves. These reviews are to ensure that wherever possible mineral or petroleum resources are not sterilised and that exploration access is maintained to potentially favourable areas. Groundwater contamination and pollution studies are another important element of the Geological Survey Division's program.

The Explosives and Dangerous Goods Division ensures that hazardous substances are transported and stored in a manner which provides maximum protection to the public and the environment.

Mining Operations

During the year 110 new mining proposals and eight environmental management programs for operating mines were received and reviewed by the Department for their environmental impact. An additional 111 proposals for major expansions to existing operations resulted in an all up total of 221 Notices of Intent (NOI) for new proposals being received — 162 were for gold ventures, 59 for base metals projects, 13 for mineral sands projects, nine for nickel projects and six for diamond projects. In total there was a 19% increase in submissions over 1989-90.

The impact and effects of environmental conditions and guidelines set by the Mines Department can be

seen clearly in many of the mining centres. Waste dump and tailings dam design and rehabilitation in accordance with Departmental guidelines has been accepted by the majority of mining companies and the improvements are evident throughout the State.

In conjunction with the Chamber of Mines and Energy, Department of Conservation and Land Management, Environmental Protection Authority and the Australian Mining Industry Council, the Department produced a video entitled 'Making the Grade' which outlined environmental management for exploration projects. The video and accompanying booklet was released in December 1990.

A report by a Ministerial work party examining conservation and rehabilitation issues in the quarry industry was released in May 1990 for public review. A revised version was accepted by the Government in February 1991 and the guidelines for the development, operation and rehabilitation of quarries were launched by the Minister in June 1991.

The role of the Mines Department in Land Conservation District Committees is gradually decreasing as the involvement of industry representatives increases, especially in the pastoral regions. The Department has encouraged industry to become involved, thereby increasing liaison and understanding between explorers, miners and pastoralists. With the industry's increased involvement in Land Conservation District Committees there has been a large exchange of information regarding techniques for land rehabilitation.

Regional Mining Development Planning Committees continued to operate in the Yilgarn and at Leonora and Laverton. In addition, specialists from industry, the Department, other Government bodies and the public held regular meetings of the Goldfields Land Rehabilitation Group. It is intended that a similar group be formed in the Murchison.

The Wonnerup clean-up operation to remove old mineral sands tailings with high radiation levels from rural and residential land continued. The operation is being carried out by Cable Sands (WA) Pty Ltd under an agreement between Cable Sands, the Minister for Mines and land owners. The project was scheduled to be completed towards the end of 1991 but greater than expected amounts of garnet sands reduced plant throughput and put the operation behind schedule.

Following a review of current tailings management practices last year, the Department prepared new guidelines on design and operational standards for tailings dams. These guidelines are due to be released shortly.

As a result of an increase in environmental staff, inspections of mining operations have been considerably increased. A number of cases of unauthorised mining were detected and resulted in successful prosecutions under the Mining Act. Further alleged offences are being assessed by the Crown Law Department. In addition a number of breaches of tenement conditions were detected. In most cases, the tenement holders were required to stop operations until appropriate environmental conditions were established.

From 1 January 1991, the Commissioner for Soil Conservation delegated authority to the State Mining Engineer to assess notification of intention to clear land for mining purposes. This delegation will enable mining projects to undergo assessment and approval from one Government authority, rather than a multitude of decision-making authorities.

A draft amendment to the Mining Act relating to the appointment of environmental inspectors was received from Parliamentary Counsel. A work party of the Mining Industry Liaison Committee has commenced drafting of regulations for environmental inspections.

Petroleum Operations

A Senior Environmental Officer was appointed to the Petroleum Division to oversee environmental aspects of petroleum operations.

Initiatives taken to improve environmental performance in the industry were:

- Advice was provided to petroleum companies regarding Government environmental legislation and directives. Companies were also reminded of any existing environmental constraints on their tenements and a number of guidelines provided to assist them in planning their environmental management programs;
- Companies' activities and rehabilitation programs were monitored and field inspections were

conducted to ensure that they complied fully with approved environmental conditions; and

- A Petroleum Conservation Consultative Committee, chaired by the Senior Environmental Officer, was established to improve communication between Government bodies, petroleum companies and conservation groups.

Mapping Support for Environmental Management

The regional environmental reserve map was maintained and continously updated. This map was in strong demand and is proving invaluable in the assessment of environmentally sensitive or restricted lands.

In addition the following mapping activities were undertaken as part of Program 3:

- Aboriginal Lands and Reserves were identified and mining tenement encroachments were entered into TENDEX database;
- Work continued on entering the approximately 3 000 Conservation Reserves into the Department's plan monitoring system and the TENDEX database; and
- A start was made towards developing a system to enable Gazetted Rare Flora to be identified at the project appraisal stage.

The Conservation Estate

During the year the Government announced a new policy on exploration and mining access to areas of conservation value. Under this policy, known as "Resolution of Conflict", exploration and mining will be banned in National Parks. New or extended National Parks will be subject to a detailed mineral and petroleum resource assessment prior to Government approval and all new National Parks or park extensions will require Parliamentary approval. The Department has an important role in preparing the resource assessments for newly proposed National Parks and conservation reserves.

Transport and Storage of Dangerous Goods

The working party set up in 1989 to examine the feasibility of prescribing routes for dangerous goods vehicles (chaired by the Department's Explosives and Dangerous Goods Division) continued to meet to finalise its report for the Western Australian Advisory Committee on Hazardous Substances. Protection of the State's important water assets in the area between Moore River in the north and the Murray River system in the south became the focus of concern to the working party. Detailed maps of the region identifying rivers, lakes, streams and wetlands have been prepared and a prioritised roads system for the area is being identified. The final report of the working party is expected to be completed in August or September 1991.

The Explosives and Dangerous Goods Division is also a decision-making authority in accordance with the provisions of the Environmental Protection Act and is required to refer proposals for the storage of dangerous goods to the EPA for assessment prior to approval. To overcome problems associated with dealing with large numbers of applications, a referrals liaison system has been implemented. Meetings of officers from Mines and EPA are used to filter applications so that minor storage applications can be cleared for processing immediately and significant proposals deferred pending implementation of the EPA's assessment scheme.

Cyanide Monitoring for Industry

Companies involved in gold mining activities in environmentally sensitive areas are assisted with their cyanide monitoring programs by the Chemistry Centre's development of analytical procedures for the accurate determination of very low levels of cyanides in effluents and groundwater.

Applied research programs include the evaluation of methods for the neutralisation of cyanide effluents and spillages, and a national project to monitor the fate of cyanide residues in tailings from mining operations.

This latter project, organised under the auspices of the Australian Mineral Industry Research Association brought together 14 company sponsors from across Australia in a $250 000 project which formally finished at 30 June 1991. Significant developments have resulted in better understanding the fate of cyanide in mine tailings and particularly the speciation of cyanide between various metallocyanide complexes both in the plant environment and in tailings disposal.

PROGRAM 4: Community Benefits

To ensure the community receives a fair return from the extraction of the State's mineral and petroleum resources.

In Western Australia, with only a few exceptions, mineral and petroleum resources belong to the community. However, under our economic system their extraction is undertaken by private sector developers.

The extraction and sale of mineral and petroleum resources provides benefits to the community. These benefits include employment, establishment of new towns and the provision of infrastructure as well as the direct financial payments made to the Government through various charges, rates and taxes. One of the charges is a royalty which represents a direct payment to the community for the loss of their non-renewable resource. As such it is a purchase price, not a tax which is a general revenue raising instrument.

The Department of Mines is responsible for the collection of mineral and petroleum royalties. This is undertaken on behalf of the State Government and the Commonwealth Government where projects lie in Commonwealth-controlled areas (eg. offshore petroleum).

Divisional Roles

While the Royalties and Policy Development Division is primarily responsible for royalty collection, assistance is provided by four other divisions.

The Petroleum Division plays a significant role in ensuring technical standards are met for oil and gas metering systems and that accurate measurement is taken of petroleum quantity and composition.

The Geological Survey and Mining Engineering divisions provide geological advice and mineral project inspections to assist in royalty determination and collection.

This work is complemented by the Surveys and Mapping Division which provides maps and site location details.

Royalty Systems

The method used to calculate royalty payments depends upon the value of the resource, the method of sale and company accounting and financial structures. In 1981 the State Government adopted as a general policy a royalty level of 10% of the ex-mine value of production. The policy required royalties to be applied to the form in which the mineral was sold with rates set for each mineral to apply across the industry.

Since 1981 the WA Government has adopted a pragmatic approach to royalties with Government and developers negotiating arrangements which achieve the overall objectives but are tailored to the individual project. For this reason a wide range of systems and rates prevails which can be categorised into three broad types:

- Specific rate royalties are generally levied on low value products. Rates range from 30 cents to 50 cents per tonne (where the level of revenue collection does not justify more sophisticated systems);
- Ad-valorem royalties are based on the value of the mineral produced with rates varying from 1.65% to 7.5% of the sales value depending on the degree to which processing of the mineral takes place before sale; and
- Profit-based royalties have a much higher rate of royalty applied (generally 20%) but are based on net profit, thus allowing companies' deductions for all production costs.

Under petroleum legislation, a rate of between 5% and 12.5% of the value of production at the wellhead is applied. Agreements are negotiated with each producer which define the method by which the petroleum recovered is to be valued. These agreements are complex and take a considerable amount of time to negotiate. Royalty is collected on an interim basis until these agreements are finalised.

Royalties Collected

The Department is responsible for the monthly collection and audit of mineral and petroleum royalties for both the State and Commonwealth governments.

During the year total payments by mineral and petroleum producers by way of royalties was $358 million, of which $324.4 million passed through State Consolidated Revenue Fund (CRF). The relationship between payments passing through the CRF account and actual royalty payments is shown in the Table below.

Total royalty payments were 19% higher than in the previous year. The State share was $297.5 million while the Commonwealth received $60.5 million as their share from offshore petroleum projects. Detailed royalty payments by commodity are included in the Financial Statements which form part of this Annual Report.

Large increases were recorded in oil royalties as a consequence of higher production (Saladin Project), LNG (the North West Shelf) and higher prices flowing from the Gulf crisis.

Royalty Audits

Royalties were paid by more than 130 companies operating under 27 Acts, including 23 State Agreement Acts which have been negotiated for specific projects.

During the year more than 500 royalty returns were examined. This involved checks at the Department's offices and company site offices. Audit manuals for the North West Shelf Project and Barrow Island were completed and sent to the Commonwealth Government for endorsement.

Negotiations continued with mineral and petroleum producers to finalise royalty arrangements and to resolve a number of related issues. These negotiations in most cases involved significant amounts and complex issues. Following discussions with mining companies, royalty collection arrangements were varied during the year for coal, iron ore and garnet.

Mining Information System

To assist in identifying companies liable for royalties and to aid statistical and management reporting, the Department is developing a computer-based database (MINEDEX). This system will include data on all mines and mineral deposits in Western Australia. Information about each mine will include location, ownership, commodity, production and stage of development. The uptake of data during the year including the task of locating and plotting mining projects and mineral deposits, was about half complete.

The system, when complete, will provide information essential to the operations of several divisions in the Department.

Legislation	Revenue Share: State	C'wealth	Total	Paid into CRF
State:				
Minerals	232.0	-	232.0	232.0
Barrow Island	9.2	27.7	36.9	9.2
Petroleum	43.8	26.9	70.7	70.7
Commonwealth:	12.5	5.9	18.4	12.5
	297.5	**60.5**	**358.0**	**324.4**

PROGRAM 5: Worker & Public Safety

To ensure that all operations in the mining and petroleum industries, and activities involving explosives and dangerous goods, are conducted in a matter that is safe for workers and the public.

In pursuing this program the Department aims to ensure that safety is the prime consideration for all workers within the mining and petroleum industry and for the public of Western Australia. The work involves legislation, guidelines, technical advice, and inspections.

Divisional Roles

Six divisions of the Department are engaged in this program including the specialised technical inspectors from the Mining Engineering, Petroleum, Explosives and Dangerous Goods divisions.

The Mining Engineering Division has inspectors based in major mining centres and these officers have the responsibility of ensuring safe working practices in all aspects of mining operations across the State. This is achieved through legislation, inspection and a comprehensive education campaign aimed at safety awareness. The division ensures all relevant provisions of the Mining Act are strictly adhered to and that the occupational health of the industry's workforce is not jeopardised or compromised. The Geological Survey Division assists through the provision of geotechnical advice.

The Surveys and Mapping Division records and preserves all plans of mines and minesites so that this information is readily available to the inspectors.

The Petroleum Division acts to ensure public and worker safety in all petroleum exploration, construction and production activity.

The Explosives and Dangerous Goods Division acts to ensure public safety at places where explosives and dangerous goods are manufactured, stored or transported.

The Chemistry Centre undertakes technical inspections and tests and provides advice on occupational health matters within the mining industry for the Department and the Environmental Protection Authority.

Safety and Working Hours

Sections of plant and mines were closed and some defective equipment taken out of service by the Mining Engineering Inspectorate as the most immediate and effective remedial action at some locations during the year. Several prosecutions were successfully instigated for breaches of the Mines Regulation Act relating to either unsafe working practices or employment of workers in excess of the number of days or hours permitted.

Open, regular communication is seen as an essential part of the division's accident prevention strategy. The division has an extensive mailing list and all mines in the State receive relevant information on a regular basis.

A survey of all principal employers and major contractors using long distance commuting for their workforce was undertaken during the year. There is little written information on the Western Australian experience with such commuting although it is needed as a basis for policy formulation.

The Findings of the Inquiry into Safe Working Practice in Underground Gold Mines in Western Australia

The report of the Inquiry commissioned by the Minister for Mines in February 1990, was released in June 1990. Many of the recommendations contained in the report did not require new action or changes in direction, but simply called on management, the workforce, the Chamber of Mines and Energy and the Australian Workers' Union to review procedures and policies and to give greater emphasis to functions or to improve aspects of performance. As such, a considerable number of these are iterative and ongoing.

Brief comment is made here on the involvement of the several parties.

The Mining Engineering Division Inspectorate: all inspectorate staff have studied the report and the regional mining engineers and district mining engineers have made extensive use of it when dealing with mine managers on issues at their operations which are covered in the report.

Many of the initiatives required of the Inspectorate have been implemented, are either in the course of implementation or being built into programs being planned or scheduled.

The report has been distributed across Australia and a number provided to overseas mines inspectorates. Copies were made available to delegates attending the Minesafe International Conference in September 1990.

An action plan in spreadsheet form has been drafted and is in the process of being discussed with the Chamber of Mines and Energy and the AWU. The purpose is to provide a systematic approach to monitoring the implementation of the recommendations and to facilitate follow up.

The Chamber of Mines and Energy and the Australian Workers' Union: a number of the most important initiatives which were recommended have been undertaken jointly by the Chamber and the AWU as matters of priority. The key items are:

- Further development and refinement of mine worker induction programs and follow through of their implementation;
- Development and implementation of an Introductory Health and Safety Representative Training Course conducted by TAFE. This course commenced in November 1990 and is booked for 1991. Department inspectors are attending these courses;
- Development and implementation of an interactive health and safety training course for personnel at all levels;
- An industry-wide approach to the management and co-ordination of mine rescue and emergency response;
- Conduct of regional seminars across the industry to ensure understanding of the Mines Regulation Amendment Act and to promote early adoption of its principles; and
- Ongoing assistance and co-ordination with the Mines Department concering the distribution of safety publications and data.

Mining Companies: all inspectors report that the impact of the Report on all mining operations, not just the underground mines, has been very positive. The Report is relevant to any mining operation, although the second section on specific issues relates mainly to underground operations.

It is evident that the recommendations have been studied and a range of them adopted.

Amendments to Mines Regulation Act and Regulations

The Mines Regulation Amendment Act No. 85 of 1990 incorporating the general duty of care provisions and the requirements for health and safety representatives and committees, passed through the Parliament on 22 December 1990. The proclamation of the Act will take place once the necessary amendments to the regulations are completed.

Amendments to Coal Mines Regulation Act and Regulations

The Coal Mines Bill has been drafted incorporating the general duty of care provisions and the requirements for health and safety representatives and committees and the drafting of new coal mining regulations is proceeding.

Fatal and Lost Time Injury Recording

The sixth report from the computer-based accident and reporting system (AXTAT), 'Fatal and Lost Time Injuries' was issued. This document presents a comprehensive analysis of injury data from the industry and information on trends in injuries that have emerged over the past two years. It is used by organisations to keep management and safety professionals informed about accident statistics, as an aid in evaluating the effectiveness of their safety programs and to promote discussion at safety committee meetings.

In addition, a publication entitled 'Western Australian Mines — Occupational Injuries 1990 Calendar Year'

Both Griffin and Western Collieries were involved in initiatives concerned with investigating levels of air blast over-pressure resulting from blasting at Collie open cut operations. A set of guidelines for control of noise and vibration from blasting was developed in consultation with the Mines Department.

Geotechnical aspects of the design and stability of open cut mine excavation walls feature prominently in ongoing initiatives by both Griffin and Western Collieries. Griffin's well-established monitoring program was of paramount importance at Muja open cut where the maximum working depth is now 270 metres.

Mines rescue team training continued to feature prominently in the coal mining industry with enthusiasm being generated in rescue team competitions, both locally and interstate.

Registration of Mine Plans

The Department maintains a register of mine plans. The indexing of these is progressing steadily with this information being entered and recorded into the MINEDEX system. Currently 150 plans have been indexed.

Safety in the Petroleum Industry

As part of a general review of safety standards in the Western Australian petroleum industry, a new Schedule of Onshore Petroleum Exploration and Production Requirements was completed and will replace the current directions on drilling operations and geological and geophysical surveys issued in 1982.

Revised draft requirements were also produced to replace the Petroleum Pipelines Regulations issued in 1970. The new document, entitled The Schedule of Specific Requirements as to Design, Construction and Operation of Petroleum Pipelines 1991, represents a significant update of the earlier regulations. Both these documents will be released early in the next fiscal year.

During the year, the Petroleum Division continued to be involved on the Consultative Committee on Safety in the Offshore Petroleum Industry (COSOP) which was established to advise on offshore safety matters in Australia following the Piper Alpha disaster in the North Sea in 1988.

Industry and union comments were sought at a meeting in Perth in April concerning recommendations arising from the Cullen public inquiry into the Piper Alpha disaster and proposed changes in legislative requirements to enhance the occupational health and safety of the workforce in the industry.

The report on the Cullen recommendations and the Australian response document, which were prepared as a result of COSOP's deliberations, will be issued to the Federal Minister for Primary Industries and Energy in the third quarter of 1991.

During the year, 53 inspections were carried out by the Petroleum Division Inspectorate compared with 45 in the previous year. This reflects the increase in exploration activity and the larger number of fields in production during the period.

A 3% increase in Lost Time Injuries was recorded compared with the previous year, but, the number of manhours worked increased by 24%. Full accident statistics are included under Workload Indicators on page 80 of this report.

Offshore operations continue to have a better safety record than onshore operations due to the higher priority placed on safety by operators in the offshore environment. Implementation of the new Schedule of Onshore Exploration and Production Requirements combined with increased surveillance of onshore operations by the inspectorate should help to redress this situation.

Public Safety

Major chemical plants received constant attention during the year, with the Explosives and Dangerous Goods Division co-ordinating the review processes between Government and industry to ensure that the risks generated by such plants were maintained at an acceptable level.

Detailed assessments of the Kemerton Industrial Parklands continued in liaison with the risk consultant appointed by the Kemerton Park Board. This resulted in suitable buffer zones being identified for the projected use of the area.

Assessment and co-ordination of Hazard Control Plans for the Kwinana industrial area continued as did

assistance in the development of the Kwinana Integrated Emergency Management System (KIEMS). KIEMS has now progressed to Stage 3, the implementation phase, which when complete will see a fully integrated emergency management system in place for the entire Kwinana industrial strip.

Third party accreditation was introduced during the year. Increased demands on the Inspectorate saw the commencement of accreditation schemes for companies to conduct hydrostatic pressure tests on tanks used for the transport of dangerous goods. In lieu of supervision of tank pressure tests, the Inspectorate was involved in the audit of company procedures and equipment allowing companies to nominate responsible officers and to conduct the tests unsupervised.

Following vandalism at a bulk explosives plant within the Kalgoorlie Explosives Reserve, a total review of security arrangements at the reserve was initiated. Recommendations arising from the review are currently being implemented.

The import and storage of ammonium nitrate figured prominently in the activities of the Explosives and Dangerous Goods Division. After considerable conjecture, two shipments were received through the port of Esperance and further shipments are expected. Hazard levels have been assessed for imports through Esperance, Dampier and Geraldton and the division has advised what action is needed to achieve acceptable public safety levels.

Road transport of explosives and dangerous goods received close attention when Westrail conducted an audit of its operations. In order to retain the regulatory control of such operations, Westrail is granted exemption from the Explosives and Dangerous Goods Act provided that is can satisfy the Chief Inspector that adequate safety measures are being taken. The agreed criteria in this instance is the ability to satisfy the requirements of the Australian Code for the Transport of Dangerous Goods by Road and Rail. Early indications are that Westrail's operations are satisfactory.

Amendments to the Explosives and Dangerous Goods Act were proclaimed during the year. Amendments necessary for the implementation of new Dangerous Goods Regulations are currently with the Parliamentary draftsman receiving final fine-tuning.

There were no reported fatalities or major injuries associated with the transport and storage of explosives and dangerous goods during the year.

An important initiative during the year was the introduction of a new quarterly newsletter titled Explosay. This initiative contributed to one of the Department's overall objectives in improving communication with clients. A comprehensive circulation list has been produced enabling information, including regulatory changes, policy decisions and accident reports, to be passed quickly to the industry.

PROGRAM 6: Chemical Services

To enhance agricultural and industrial development, and the protection of community, consumer, environmental and health standards, by providing high-quality independent chemical services to Government, industry and the public.

This program encompasses the key role of the Chemistry Centre which is to provide a range of highly specialised services to Government, industry and the Western Australian public. Specifically it relates to those activities outside the investigative and consultancy services undertaken in Programs 2 to 4.

Activities undertaken during the year in support of this program included forensic science, drug detection, water analysis, food pesticide checks, occupational health issues and consumer complaints.

Soils from a failed dam at the Manjimup Horticultural Research Station and some unusual soils from the proposed North Dandalup Dam were examined for exchangeable cation characteristics by the Agricultural Chemistry Laboratory. Some soils have the unusual feature of higher levels of exchangeable sodium and magnesium than calcium. This makes them potentially unstable and unsuitable for dam construction. Further investigations of Darling Scarp soils for dam construction have continued.

The nutrition of horticultural crops on coastal plain sandy soils in Western Australia continues to have important implications for the control and understanding of the eutrophication of estuaries and the pollution of groundwater. Agricultural Chemistry Laboratory staff have, in joint work with the Department of Agriculture, continued activities in this area. Two publications, one on Phosphate and Sulfate Adsorption Properties of Soils from the Coastal Plain of Southwest Western Australia and the other on Responses of Carrots to Phosphorus Use on Sandy Soils were completed by laboratory staff.

The Agricultural Chemistry Laboratory was represented by Dr D Harris at the 6th International Lupin Conference in Chile during November 1990. He presented four papers at the meeting, which confirmed that the laboratory's activities in the lupin area are recognised world wide.

Substantial funding by agricultural research granting bodies enabled the Agricultural Chemistry Laboratory to acquire important new instruments for the analysis of agricultural materials. An inductively coupled plasma atomic emission spectrometer ($130 000 contributed) and a nitrogen analyser ($40 000) were installed during the year.

An important aspect of the Chemistry Centre's activities is to utilise its various areas of expertise to train staff in other Government instrumentalities and industry. The Health Chemistry Laboratory, for example, was involved in conducting a variety of lectures and seminars on occupational health issues . These included presentations to TAFE, CALM and mining industry staff at surface and underground ventilation officers courses held by the Department. Similarly, Forensic Science Laboratory staff were involved as instructors and observers in a four-day course with the Police Forensic Branch which conducted a major training exercise on explosives and bomb scene investigation. Part of the exercise involved an actual bombing and full bomb scene investigation. The exercise was designed to train the Police in explosive residue detection and at the same time provide the Forensic Science Laboratory staff with some real bomb scene evidence on which to test their laboratory procedures.

The Chemistry Centre generally does not compete with private industry and where possible diverts routine analytical work to private laboratories. It exists principally to solve chemical problems which arise in Government instrumentalities and industry. One such problem referred to the Environmental Chemistry Laboratory was a concern over the efficiency of hospital incinerators and the consequent potential for atmospheric pollution. As a result of a joint study with the

Health Department and Environmental Protection Authority at one hospital, modifications proposed by the Environmental Chemistry Laboratory were put into place which enabled the hospital to combust normal hospital waste in a safe and complete manner. Among the recommendations were a higher combustion temperature and the retention of the gases at the higher temperature for longer periods. Examination of air samples from chimney stack emissions after modification, demonstrated that all organic matter was combusted.

The Government's policy of support for locally produced new materials has been hampered by the lack of available research and analytical facilities. In an attempt to accommodate this problem, the Chemistry Centre has bolstered its resources in the Materials Science Laboratory. Corrosion study is an important aspect of this work and many investigations were carried out for Government and the private sector. The use of a range of analytical techniques, including scanning electron microscopy, X-ray diffractometry, Fourier transform infra-red microscopy and inductively coupled plasma spectrometry allowed complete characterisation of corrosion products. Solutions were provided to problems presented in the form of electrowinning anodes, steel filtration meshes, metal gears and surgical instruments.

The Racing Chemistry Laboratory's prime function is to monitor blood and urine samples in connection with horse and greyhound racing and pacing as part of the program to keep the animals free of drugs at the time of racing. Despite the extensive program, 18 positive findings were reported which consisted mainly of anti-inflammatory drugs (steroidal and non-steroidal) and the stimulant caffeine. An innovation was the testing of jockeys and drivers, an initiative to be taken up soon in the other States. After only a short period of operation four positive cases have resulted.

In order to provide an effective service to the Police it is vital that applied research and investigation be carried out on an on-going basis. One such investigation is a project to establish a means of discriminating and identifying lipsticks. Lipsticks are materials which are quite likely to be transferred to offenders during assaults on females. A novel technique of simultaneous pyrolysis methylation developed in the Forensic Science Laboratory has proved useful in profiling fats, waxes, oil and lanolin on minute amounts of material. Fifty lipsticks have been examined by this technique and also by conventional gas chromatography with a proportion selected for further analysis using mass spectral compound identification. The range and concentrations of components detected has enabled a very effective classification system to be devised which surpasses any previous techniques in use.

The Food Monitoring Program continued on a limited scale due to restricted funding. An investigation was undertaken into mercury levels in shark species found in Western Australian waters. Following discussions with the Department of Fisheries and other interested authorities, a report was submitted to the Health Department. Analyses for a survey on sulfur dioxide in a range of foodstuffs have been completed and a report compiled. Work also commenced on lead crystal glassware to determine the rates at which lead is leaching into wines and spirits. Reports on each of the above projects are due to be released before the end of 1991.

The Chemistry Centre has assisted:

- The Health Department to establish that off-the-shelf bottled mineral waters generally complied with the labelling requirements of the Food Code but that Australian products breached the Code more than imported waters;
- The State Tender Board by writing specifications for many new cleaning and polishing products. The specifications were written to reflect both the needs of users and the environmental concerns of the community;
- The Western Australian Museum by devising methods to discriminate between genuine elephant ivory and a range of substitutes. Apart from enabling the Australian Customs Service to specifically identify ivory as genuine and correctly assess the duty, this work assisted the Fremantle Maritime Museum in restoration of ivory from shipwrecks;
- CALM in establishing that the levels of the timber control herbicide Tordon were low, thus allaying fears of its staff that exposure to the chemical presented an occupational health problem;
- Western Australian Water Police in confirming that the cylinder of gas used in a diving fatality was nitrogen instead of air;

- The Ministry of Consumer Affairs in an instance where the cause of "fretting" brickwork on a private residence was identified as under-firing of the bricks during manufacture;
- The Agricultural Protection Board and the Environmental Protection Authority with an extensive residue analysis program in relation to the Government's locust control campaign by assessing fenitrothion levels in the environment;
- The International Association of Forensic Toxicologists meeting in Perth, through the Forensic Science Laboratory and the Racing Chemistry Laboratory, by contributing nine papers as well as helping to successfully organise the meeting;
- The Western Australian Water Authority to investigate the groundwater quality compliance with accepted guidelines for organic pollutants in the Geraldton and Esperance regions. This work followed an extensive metropolitan area survey in 1989-90. Traces of disinfection by-products have been detected in most reticulated water supplies but at levels well within internationally-acceptable guidelines;
- The Waterways Commission to examine fish species in the Swan and Canning river systems for organo chlorine pesticide contamination. An initial survey of 60 samples indicates acceptable levels but traces of dieldrin and some other organochlorine pesticides were detected over a wide area; and
- A Western Australian producer in characterising emu oil.

Organisational Developments

Funding was not allocated to the Chemistry Centre's Bentley complex in 1990-91. A proposal for a staged building program for the transfer of the Bentley and Hay street facilities to Bentley was put to Government for funding in 1991-92.

Further modifications have been made to the Hay Street building to improve safety and occupational health conditions. Major problems were encountered during renovations to house new equipment — asbestos fibres from degraded asbestos cement fume cupboards were accidentally distributed through some laboratories. This problem will place restrictions on future building renovations and maintenance.

The lack of funding for information technology has limited the development of the support and management systems needed to fully implement the accountability systems. Government clients have since 1 July 1990 been notified with each report of the notional cost of their work. This cost was calculated to be the full cost and includes salary, salary on-costs, running and equipment costs and rent.

PROGRAM 7: Corporate Services

To ensure that the human, financial and other resources of the Department are used efficiently and effectively to provide a service responsive to the needs of the community, industry and Government.

The corporate services function provides administrative support services to the Department's Corporate Executive and the other eight operating divisions of the Department.

These services relate to corporate planning, capital works, management services, computing services, typing services, financial services, human resources and internal auditing and are necessary for the Department's effectiveness.

The nature of these internal services is not only affected by the requirements of the operating divisions but is influenced by Government policy and the requirements of agencies such as the Department of Premier and Cabinet, Public Service Commission, Treasury, Office of Government Accommodation, State Services and Building Management Authority.

The consolidation of the service providers into a corporate services function ensures:

- A focal point for contact by Department management and operating divisions;
- Co-ordinated responses to Government and external central agencies; and
- Economies of scale and the avoidance of duplication.

The following report on the activities flowing from the coporate services function describes the contributions being made towards achieving the Government's desire to improve the effectiveness and efficiency of its operations.

Corporate Planning

The Department's commitment to corporate planning was continued during the year with the secondment of the Manager, Financial Services to the position of Corporate Planner.

With the introduction of program management into all Government departments, the Department made a commitment to comprehensive integration of the corporate planning and budgeting processes. Thus the terms of reference for the appointment of the Manager, Financial Services as Corporate Planner was specifically prescribed as 'linking the philosophical view of organisational objectives as defined in the Corporate Plan into the budgeting and resources management processes of the Department'.

During 1990-91 the organisational framework of the Department was refined and developed so that as far as possible the components of the departmental programs in the Corporate Plan represent cost centres within the operating divisions of the organisation.

A new operational plan for 1991-92 is currently being prepared to reflect the revised components of the Corporate Plan. This will form the basis of divisional quarterly reports which advise program managers of progress and actions to be taken in implementing the Corporate Plan.

Performance indicators were reviewed in 1990-91, and micro indicators of performance against desired outcomes now form part of the quarterly reporting process. Further work will be undertaken in 1991-92 on the redevelopment of broad indicators of program effectiveness.

The strategic plan for 1991-92, which presents strategies and specific actions which need to be taken over the next twelve months to address the key issues confronting the organisation, is nearing completion and will be issued early in the new financial year.

Management Services

The Management Services Branch fulfils a wide range of functions which have an overall impact on the

Department's resource management, ranging from supply of goods and services and project management, to property services and capital and minor works.

Since assuming responsibility for its own purchasing and disposal in June 1989 the Department has been in the forefront of developing and implementing new Government initiatives. These initiatives include:

- The introduction of a corporate credit card (Mastercard) to supplement the computerised purchasing system; and
- The implementation of the Supplynet system. The Department commenced a pilot study on electronic trading including sending orders electronically to selected suppliers.

Management Services carried out a number of reviews during the year designed to evaluate and improve performance. These included the review of the Chemistry Centre library and the implementation of a computerised asset management register.

Management Services also conducted a pilot study of energy management within the Mineral House complex in conjunction with the Building Management Authority and private consultants. The procedures implemented resulted in the complex receiving a 6% saving in its energy consumption figures.

Capital and Minor Works

During the year, significant effort was directed at occupational health, safety and welfare issues within the Department.

Works undertaken were:

- Completion of 44 occupational health, safety and welfare projects within the Chemistry Centre — $248 294;
- Completion of alterations to the Agricultural Science Laboratory — total $119 733 of which $80 000 was privately funded;
- Completion of the Chemistry Centre's Kalgoorlie Metallurgical Laboratory's noise and dust abatement project — $53 643;
- Continued assistance with planning the proposed Chemistry Centre complex, Bentley, and associated CSIRO mineral research facility — $500 000;
- Co-ordination and implementation of the Chemistry Centre's Material Science Laboratory upgrade — $273 000; and
- Co-ordination and management of occupational health, welfare and safety minor works totalling $43 000.

Computing

The impact of budget restrictions has resulted in the deferment of some information projects. Nevertheless the enthusiasm and significant contribution of staff has enabled the Department to develop some quality information systems for the operating divisions and industry.

The Department's usage of computer-based information systems has continued to increase. The 19 on-line systems now account for 19 000 transactions per day, with the off-line reporting functions adding half as much again. The increasing load on the central computer is in line with the capacity plan which foreshadows the need to upgrade very early in 1992-93.

One of the features of the year's work was the enhancement and closer integration of information systems relating to mining tenements. The major change related to the introduction of graticular sections for exploration licences but supporting this initiative a considerable amount of work was done to bring TENDEX (a tenement index) and other associated systems into a data structure.

Mining Registration Division is making steady progress towards the goal of an electronic register to replace the manual registers of mining titles maintained since 1894. A major step forward was the introduction of the on-line tenement rental and expenditure system, TRAXS, which is basically a part of TENDEX. The two systems are closely tied by common tenement data. The system will reconcile rental demands and payments, permit rent to be paid at any office and issue notices. The last function will ensure that holders of the several thousand live tenements receive notification of rent due and a reconciliation of rent due and paid in previous years. It is anticipated that the system will ensure prompt and efficient collection of rents, thus increasing revenue and providing improved monitoring of the tenement expenditure conditions.

The Petroleum Exploration Index System, WAPEX, was further improved by linking the system to the records management system. WAPEX is an index to about 60 000 reports and 40 000 geophysical maps. The WAPEX-RMS link now enables the reports to be bar-coded, their locations recorded and loans tracked. WAPEX is now an integral part of the Basins and Fossil Fuels Branch's daily operations.

The Department has continued to develop its resource-based information systems, completing the Mineral Information System — MININFORM. Currently 2 400 sites are recorded of which 507 are operating mines. Details of resource information and operating projects are maintained by the Geological Survey Division and can be accessed through the Mineral Information Index System, MINEDEX. The third stage, completed but not yet implemented, is Mining Engineering Division's new Mining Operations System, MINEOPS. This system ensures that regulatory and inspections data on valid mining projects, sites, equipment and machinery is maintained.

Since August 1979 the Department has maintained computer-based data on atmospheric dust samples at mine sites. The new contaminant monitoring system, CONTAM 2, completed in June 1991, is more extensive in scope and will contain data gathered since 1 July 1986. It is linked to MININFORM and MINEOPS to ensure consistency of data.

The Department has made significant progress in establishing a local area network (LAN) within Mineral House. Following earlier trials in the Mining Engineering Division, Computer Services are now implementing a sophisticated LAN. A central computer will be used for data storage and backup services for the network.

During the year computing staff assisted the Mining Registration and Surveys and Mapping divisions to commence work on a system to display mining tenement graphical information on computer screens. This system, TENGRAPH, is the first to use workstations to process data obtained from and maintained on the central computer within a single application framework. The development of such a graphics-based system has far-reaching implications for data handling and communications. Following the completion of a user requirements study work is continuing on prototype development and the specification of the system.

Word Processing

Typing staff during the year have been busy with the section often under severe pressure. Emphasis has been placed on recruitment and personal development with an increased number of staff attending training courses to raise the quality of typing services.

The ageing Wordplex equipment has proved difficult to maintain and within funding restrictions a graduated replacement plan is being implemented. The replacement plan using the new LAN network and microcomputers will utilise standarised "Word for Windows" word processing software and is planned for implementation in 1991-92.

Records Management

To improve records management operations 'project files' have been created to cover around 550 individual projects (95% of the total). "Structured File Titling" has also been another major initiative and following liaison with divisions, prime headings for each major subject category were established.

This year has seen a large increase in the microfilm program with 20 000 inactive files being filmed and destroyed to make better use of available physical storage areas.

Information technology continued to play a significant role in providing effective services to the Department and industry. During the year further use of the computerised records management system was made to improve information management by:

- Establishing a database and barcoding facility for the "S-Series" Petroleum Reports; and
- Providing a reporting facility on the current status of Ministerial correspondence.

Recognising the high standard of information management within the Department the Records Manager was selected to establish and administer the complex records function for the Government Royal Commission.

Telecommunication Services

The new Fujitsu 9600L PABX System commissioned in January 1990 performed well, and provides effective communications for the Department and its clientele.

The Carlisle complex PABX, serving the Exploration Safety and Drilling Branch, the Geological Survey laboratories and transport store, was upgraded to provide direct indial facilities to users.

Continued monitoring of telephone usage through the computerised Telephone Information Management System has ensured effective and efficient use of PABX facilities and cost control.

The use of facsimiles as a means of hard copy communication continues to grow. During the year the Department's general facsimile machines were upgraded to plain paper laser printer units.

The level of activity, user needs and technology advances will continue to be monitored to ensure that the Department is utilising this mode of communication effectively.

Financial Management

With the introduction of program management it has been necessary to link the budgeting and financial reporting processes of the Department with the Corporate Plan.

During 1990-91 the financial management information system underwent a major redevelopment to enable budgeting and financial management reporting to be conducted on both a program basis and a divisional basis. The monthly reports provided to management throughout the year have provided the following:

- A whole of Department matrix report to enable the Chief Executive Officer to view the finances of the seven programs and nine divisions of the organisation in one comprehensive statement;
- Program reports to facilitate program management;
- Divisional reports to facilitate divisional management by directors; and
- A series of lower level reports to facilitate cost centre management by branch and section managers.

The Parliamentary appropriation of the budget was a "one line" appropriation for the first time in 1990-91 and gives the organisation greater flexibility to determine priorities and allocate funds throughout the year. The financial statements were therefore presented in program format for the first time this year.

Human Resource Management

The Department experienced reductions to its staffing levels as a result of restraints on their recruitment of staff and in particular the closure of the Drilling Branch. This closure necessitated the redeployment of 40 officers either to other branches of the Department or to other Government agencies. The restrictions on recruitment also affected other human resource services and this resulted in redeployment and intensive training initiatives for personnel being the prominent staffing issues during the year.

In 1990-91 the Department's Approved Average Staffing Level (AASL) was 765.78 Full Time Equivalents (FTEs), and the continued development of planning and monitoring strategies enabled the Department to operate effectively within this level.

The rate of turnover was reduced by approximately 13% on the previous year with 137 staff resigning or retiring. However, restrictions on the filling of vacancies resulted in only 107 new staff being recruited.

Intensive training initiatives continued with over 752 staff attendances being recorded against a variety of management, development and technical courses, seminars and workshops during the year. Total eligible training expenditure for the year exceeded the 1% required under the Training Guarantee Act, 1990.

A Department training and development committee was established to monitor needs common to divisions, investigate training and development policy and procedures, and review Departmental programs.

Inter-active video and computer-based training programs were again well patronised, and in-house communication skills and posture education courses were provided for staff. These courses will form part of an annual program of training and development activities.

Proposals for performance management systems were circulated to the remaining divisions without formal systems. Implementation is due to be completed during 1991-92.

Occupational health and safety initiatives instigated during the year have been extended with the following consultancy service:

- Rehabilitation programs for all staff following work related injuries;
- Workplace assessments to ensure safe working conditions and environments;
- Health education programs designed to prevent accident or injuries;
- Confidential counselling service for work and personal issues that may impinge on staff productivity; and
- Claims management for all workers' compensation claims.

Initiatives in occupational health and safety have resulted in a reduction in the Department's workers' compensation premium. During the year there were 39 workers' compensation claims of which 31 were accepted, four rejected, and the remaining four are under consideration.

An update of the Equal Employment Opportunity Management Plan was commenced and is due to be presented to the Directorate of Equal Opportunity in Public Employment in August 1991. The Department's last Annual Review was well received by this organisation.

Internal Audit

During the year, nine system-based audits were carried out in accordance with the strategic audit plan. Audits were also conducted at seven of the Department's regional offices including the Kalgoorlie Metallurgical Laboratory. This coverage represented a significant cross-section of the strategic audit plan for the 1990-91 financial year.

A review of the function and structure of the Internal Audit Branch was conducted by Management Services. The report recommended an increase in staffing levels for the branch to achieve full audit coverage, however, current staffing restrictions preclude action on this recommendation.

Accounting

The financial statements for the year ended 30 June 1991 have been prepared in accordance with the provisions of the Financial Administration and Audit Act, 1985 and the Treasurer's Instructions issued pursuant thereto. To assist in comparisons with other Government agencies they follow the format suggested in the appendices to the Treasurer's Instructions.

The Statements are prepared on a cash basis in that only collections received and payments made are included.

The Statement of Consolidated Revenue Fund Receipts (Table 1) provides details of actual revenue received and credited to the fund. This is compared with the Consolidated Revenue Fund estimates under the headings "Territorial" and "Departmental" revenue where Territorial Revenue is revenue which has not been generated from fees and charges levied for services provided by the Department. Details of actual revenue for the previous financial year have also been provided to enable comparisons to be made.

Revenue

Consolidated Revenue Fund

During the financial year the Department was responsible for the collection of $380.5 million through the Consolidated Revenue Fund (CRF), this being $61 million more than in 1989-90. Mineral and petroleum royalties collected from companies operating under State legislation comprised 85 per cent of this amount. Part of the revenue was also payments collected by the State on behalf of the Commonwealth for petroleum produced within Commonwealth waters. These receipts subsequently were paid to the Commonwealth by way of special purpose payments after payment into CRF.

In addition to royalties, the Department collected lease and other rental charges (Figure 10) and Departmental revenue. The latter, while considerably less as a proportion (1.7%), was still significant ($6.4 million) and represented charges for goods and services provided by the Department (Figure 11). The Departmental revenue largely originated from charges associated with the Registration, Explosives and Chemistry Centre divisions (Figure 11).

Expenditure

Consolidated Revenue Fund

Funds are appropriated by the Parliament through the Consolidated Revenue Fund to provide for the operating costs of the Department. This appropriation includes provision for equipment replacement as well as refunds of revenue collected in previous financial years. It also includes expenditure which relates to activities of the mining and petroleum industries which are not operating costs of the Department. For example, costs associated with the Western Australian Coal Industry Council are included. This council provides a forum at which unions, coal mining companies and Government meet to gain a better understanding of industry needs. The payments, financed through the Consolidated Revenue Fund (Figure 9), are related to the seven programs undertaken by the Department.

During the financial year the Department's CRF expenditure budget of $42.228 million was overspent by $1.921 million (4.5%). This was as a result of under provision in the original assessment of the level of funding required for salaries, and a higher level of refunds of revenue collected in previous years relating to mining tenements which were either refused by the Department or the company deciding not to proceed.

Special Acts

An appropriation is made under the provisions of the Petroleum (Submerged Lands) Act 1982 for the Commonwealth's share of royalties received from offshore operations. The Commonwealth revenue has been collected by the State into the Consolidated Revenue Fund. Payments to the Commonwealth totalled $26.940 million in the year, a very large increase on the $12.205 million paid in the previous year (Table 2).

General Loan and Capital Works Fund

Major capital works projects are financed under the State's Capital Works Program from the General Loan and Capital Works Fund.

During the year $341,221 was expended on capital works funded from this source (Table 3).

Financial Management

In accordance with the Government's accountability concept, the Department has continued to develop reporting mechanisms which provide the Accountable Officer with timely and comprehensive financial management reports to assist in resource allocation decisions. During the year the financial management information system was substantially modified to link the philosophical view of organisational objectives as defined in the Corporate Plan into the budgeting and resource management processes of the Department.

Pricing Policy

The Department generally adopts a full cost recovery user pays approach in determining fees and charges for services provided to the public and industry. With some services, where there is considered to be an element of "service to the general public", a nominal fee has been determined. However, this represents only a small fraction of services provided and has minimal impact on revenue.

To further refine and enhance the full cost recovery user pays policy, the Department is currently undertaking a comprehensive review of fees and charges. This will ensure that fees charged are appropriate and that where necessary, commercial cost accounting systems are developed and implemented during the 1990-1993 triennium.

A comprehensive review of the fees and charges levied by the Chemistry Centre was conducted during the year. The new cost accounting framework developed the previous year was reviewed and redefined. In addition to charging for services provided to non-Government clients and Government trading concerns, a system of notional charging has been developed for services provided to other Government agencies. This initiative is a precursor to charging for services provided to these agencies by the Chemistry Centre if the Government decides to implement this procedure.

Royalty Policy

The Department has a corporate objective of ensuring that the community receives a fair return for the removal of non-renewable resources owned by the people of the State. The Department aims to ensure that these royalties are collected on time and in an economically and administratively efficient manner. Royalties were revised during the year for some commodities.

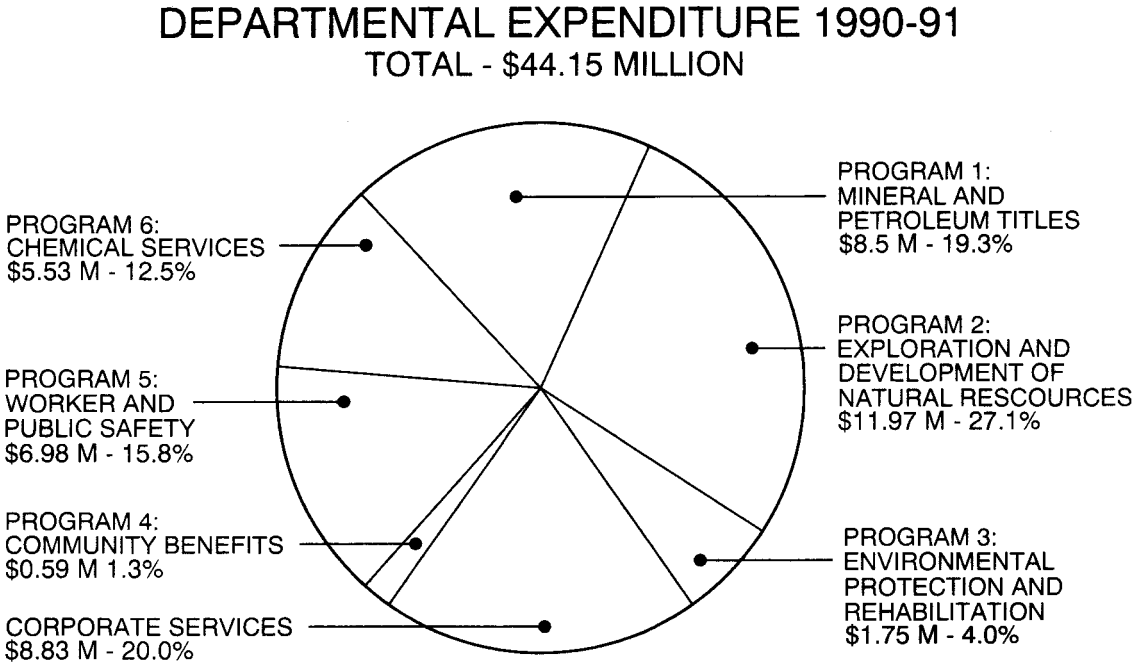


Figure 9

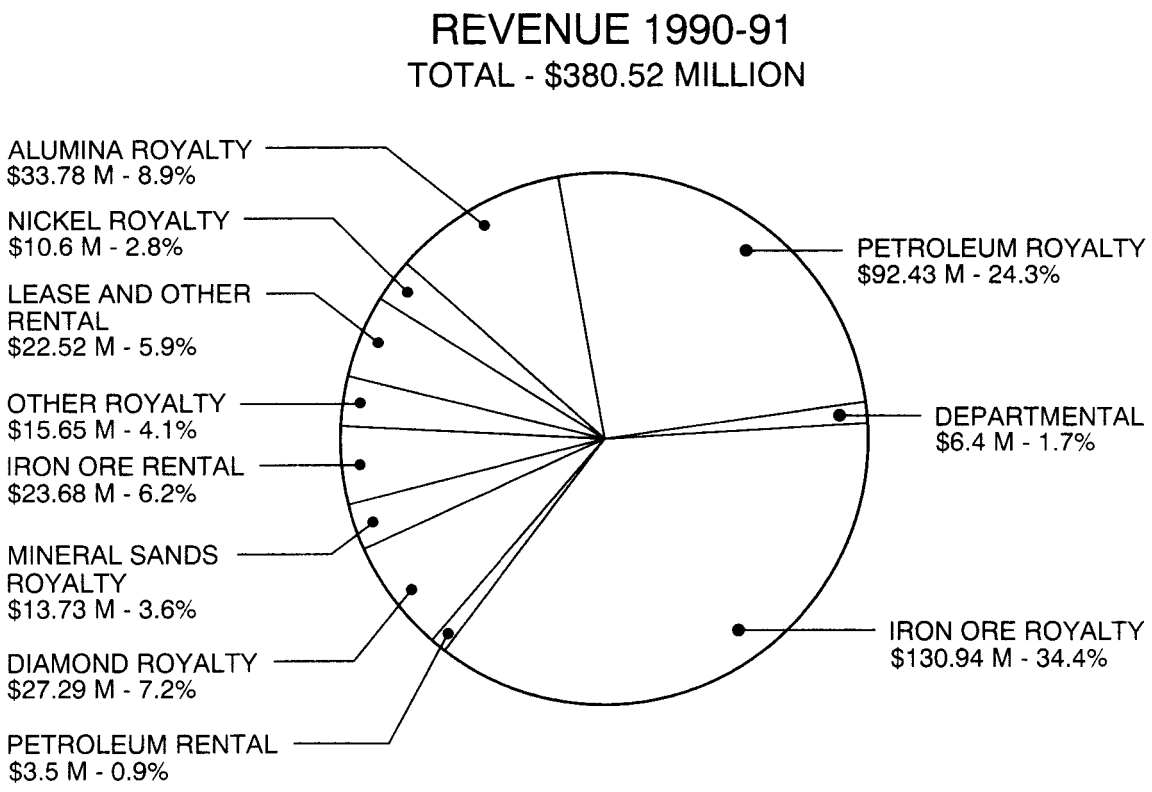


Figure 10

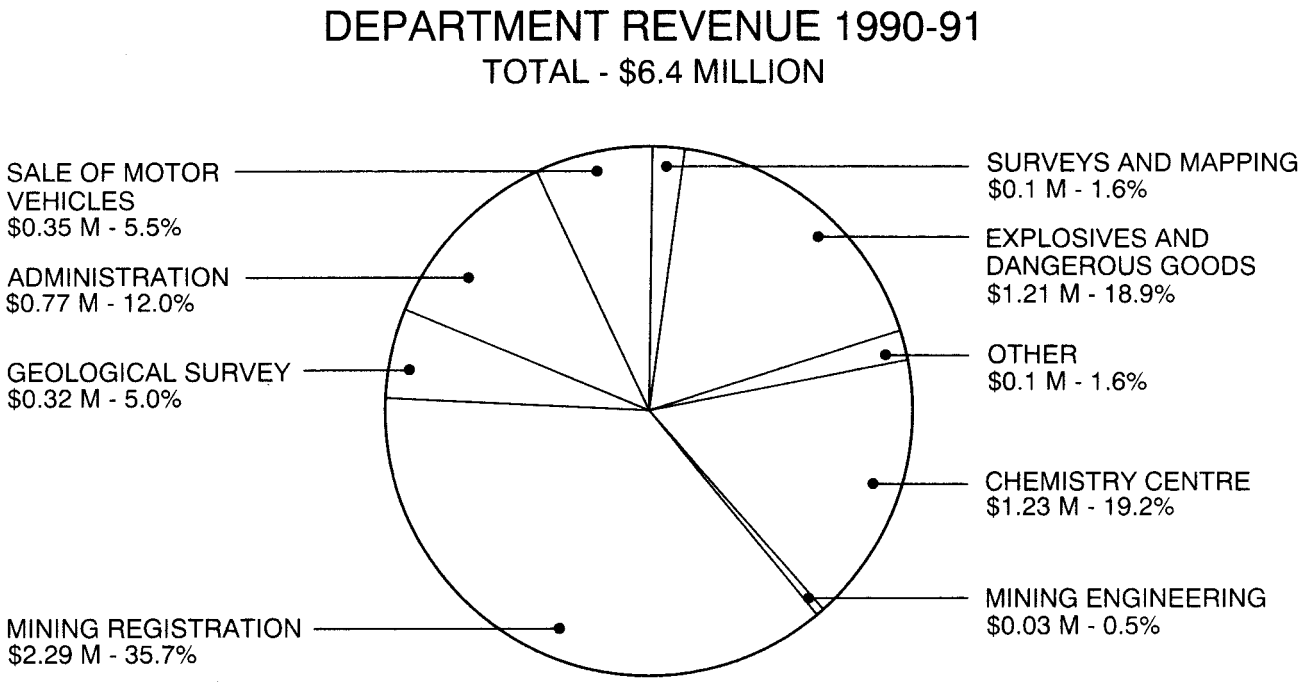


Figure 11

FINANCIAL STATEMENTS

Table 1: STATEMENT OF CONSOLIDATED REVENUE FUND RECEIPTS

1989/90		1990/91		
Actual $		Estimate $	Actual $	Variation $
	TERRITORIAL			
	Royalties			
112 532 211	Iron Ore	123 000 000	130 935 141	7 935 141
51 777 319	Petroleum	75 500 000	92 427 106	16 927 106
27 202 476	Diamonds	25 500 000	27 289 552	1 789 552
34 072 745	Alumina	35 500 000	33 777 840	(1 722 160)
18 293 186	Mineral Sands	20 500 000	13 734 122	(6 765 878)
9 978 062	Nickel	10 500 000	10 597 323	97 323
10 365 997	Other	16 500 000	15 650 608	(849 392)
49 018 095	Lease and Other Rentals	50 000 000	49 708 461	(291 539)
313 240 091		**357 000 000**	**374 120 153**	**17 120 153**
	DEPARTMENTAL			
2 317 120	Registration	2 385 000	2 290 162	(94 838)
1 146 193	Chemistry Centre	1 011 000	1 233 968	222 968
1 198 831	Explosives	1 049 000	1 206 785	157 785
728 800	Sale of Motor Vehicles	305 000	350 550	45 550
403 607	Administration	500 000	766 658	266 658
289 144	Geological Survey	325 000	322 820	(2 180)
115 451	Surveys and Mapping	147 000	105 481	(41 519)
24 267	Engineering	37 000	26 436	(10 564)
29 839	Other	32 000	101 908	69 908
6 253 252		**5 791 000**	**6 404 768**	**613 768**
319 493 343	Total Receipts	**362 791 000**	**380 524 921**	**17 733 921**

Explanations of variations between the current year estimates and actual results, and the actual results compared with the preceding year, are set out in Note 2.

Table 2: STATEMENT OF CONSOLIDATED REVENUE FUND PAYMENTS

1989/90 Actual $		1990/91 Estimate $	1990/91 Actual $	Variation $
	Division 42 — Mines			
44 846 000	Item 126 Amount provided for Services for the year	**42 228 000**	**44 148 920**	**1 920 920**
	Description			
9 729 000	**Corporate Services**	**9 638 000**	**8 827 973**	**(810 027)**
	Program 1:			
6 748 000	**Mineral and Petroleum Titles**	**8 441 000**	**8 498 257**	**57 257**
	Sub Programs			
4 821 000	Title Systems	6 908 000	6 844 398	(63 602)
1 927 000	Dispute Management	1 533 000	1 653 859	120 859
	Program 2:			
12 573 000	**Exploration and Development of Natural Resources**	**11 024 000**	**11 971 448**	**947 448**
	Sub Programs			
6 853 000	Geological Data Collection	3 559 000	3 971 535	412 535
2 113 000	Metallurgical and Analytical Services	2 773 000	2 921 588	148 588
1 773 000	Geoscientific Data Dissemination	3 017 000	3 449 163	432 163
1 501 000	Geotechnical and Mining Engineering Advice	601 000	842 172	241 172
333 000	Community Relations	1 074 000	786 990	(287 010)
	Program 3:			
759 000	**Environmental Protection and Rehabilitation**	**1 577 000**	**1 750 758**	**173 758**
	Program 4:			
3 161 000	**Community Benefits**	**461 000**	**590 715**	**129 715**
	Program 5:			
6 039 000	**Worker and Public Safety**	**6 171 000**	**6 984 524**	**813 524**
	Sub Programs			
4 596 000	Workers' Safety and Health	4 659 000	5 572 996	913 996
1 443 000	Management of Dangerous Goods	1 512 000	1 411 528	(100 472)
	Program 6:			
5 837 000	**Chemical Services**	**4 916 000**	**5 525 245**	**609 245**
44 846 000		**42 228 000**	**44 148 920**	**1 920 920**
	Special Acts Expenditure			
12 204 993	**Petroleum (Submerged Lands) Act 1982**	**14 000 000**	**26 940 348**	**12 940 348**

Explanations of variations between the current year estimates and actual results, and the actual results compared with the preceding year, are set out in Note 2.

Table 3: STATEMENT OF CAPITAL WORKS PAYMENTS AND SOURCE OF FUNDS

Actual Expenditure 1989-90 $	Activity	1990/91 Estimate $	1990/91 Actual $	1990/91 Variance $
	COMPLETED WORKS AND WORKS IN PROGRESS			
	CHEMISTRY CENTRE (WA)			
196 237	Alterations	54 000	52 057	(1 943)
14 187	Agricultural Science Laboratory	26 000	25 546	(454)
58 991	Mineral Science Laboratory	–	–	–
	KALGOORLIE METALLURGICAL LABORATORY			
12 584	Noise and Dust Abatement	47 000	41 059	(5 941)
	KALGOORLIE EXPLOSIVES RESERVE			
103 003	Security Office	–	–	–
1 096 998	MINERAL HOUSE STAGE 2	–	–	–
	NEW CHEMISTRY CENTRE COMPLEX BENTLEY			
445 000	Planning Fees	55 000	52 558	(2 442)
	NEW WORKS			
	CHEMISTRY CENTRE (WA)			
	Material Science Laboratory Upgrade	170 000	170 000	-
1 927 000	**TOTAL**	**352 000**	**341 220**	**(10 780)**
	SOURCE OF FUNDS			
1 927 000	General Loan and Capital Works Fund	**352 000**	**341 220**	**(10 780)**

Accounts of the Trust Fund

Survey of Leases Under the Mining Act Account

Survey fees collected under the Mining Act are paid into this account. The actual cost of surveys is charged to the Consolidated Revenue Fund, and fees previously collected are then transferred to Consolidated Revenue. If the applicant decides not to proceed with the survey, the fee collected is refunded.

	1989-90 $		1990-91 $	
Opening Balance July 1	5 585 328	CR	6 393 046	CR
Add Receipts				
Survey Fees	1 548 729		1 138 816	
	7 134 057		**7 531 862**	
Less Payments				
Transferred to Revenue	322 890		361 748	
Refunds	418 121		1 050 616	
Total Payments	**741 011**		**1 412 364**	
Closing Balance June 30	**6 393 046**	**CR**	**6 119 498**	**CR**

Chemistry Centre Trust Account

The account was created to hold monies received from industry and other organisations for the purpose of conducting specific projects.

	1989-90 $		1990-91 $	
Opening Balance July 1	70 580	CR	238 376	CR
Add Receipts				
Contributions From				
Industry	333 101		267 342	
Government	-		214 660	
Total Receipts	333 101		482 002	
	403 681		**720 378**	
Less Payments				
Salaries	18 868		277 176	
Travel	11 448		10 041	
Equipment, Misc	134 989		276 740	
Total Payments	**165 305**		**563 957**	
Closing Balance June 30	**238 376**	**CR**	**156 421**	**CR**

Barrow Island Royalty Trust Account

The account was created under the Barrow Island Royalty Trust Account Act 1985 which provides for royalty payments received under the Barrow Island lease to be credited to the account and subsequently apportioned between the Commonwealth and the State.

	1989-90 $		1990-91 $	
Opening Balance July 1	0		5 609 575	CR
Add Receipts				
Royalties Received	45 486 980		36 883 886	
*C'wealth share of Royalty refund	7 302 288		-	
Total Receipts	52 789 268		36 883 886	
	52 789 268		**42 493 461**	
Less Payments				
Transferred to Revenue	11 371 745		9 199 894	
Remitted to C'wealth	28 505 660		25 207 006	
*Refunds of Royalty (i)	7 302 288		-	
Total Payments	**47 179 693**		**34 406 900**	
Closing Balance June 30(ii)	**5 609 575**	**CR**	**8 086 561**	**CR**

(i) Refunds of royalty due to quarterly provisional receipts exceeding assessed royalty due.

(ii) Commonwealth share of royalty payment payable in July 1991 $8 065 484 and State share of overpaid royalty to be refunded to Wapet $21 077.

Deposits: Mines Department Account

Funds held are received for the issue of temporary reserves and exploration permits pending finalisation of certain legal requirements.

The refunds of deposits and transfers to the Consolidated Revenue Fund following finalisations during the year decreased the amounts held to $301 954 at June 30, 1991.

	1989-90 $		1990-91 $	
Opening Balance July 1	382 015	CR	305 706	CR
Add Receipts				
Bonds, Securities	211 360		427 990	
Interest	1 031		52 123	
	594 406		**785 819**	
Less Payments				
Refund of Bonds, Securities	288 700		401 100	
Refund of Interest			2 828	
Transfers to Revenue				
•Interest			44 552	
•Bonds, Securities			33 700	
•Other			1 685	
Total Payments	**288 700**		**483 865**	
Closing Balance June 30	**305 706**	**CR**	**301 954**	**CR**

Transfers to Suspense Account

The account is maintained to hold funds to meet any relevant end of year commitment in respect of plant and equipment or land.

	1989-90 $		1990-91 $	
Opening Balance July 1	474 500	CR	139 307	CR
Add Receipts				
Transfers ex CRF - Plant & Equipment	139 307		89 669	
	613 807		**228 976**	
Less Payments				
Purchase of Plant & Equipment or Land	474 500		199 976	
Closing Balance June 30	**139 307**	**CR**	**29 000**	**CR**

Treasurer's Advance

Drilling

Recoverable drilling expenditure is initially charged to a Treasurer's Advance Account. The cost of work performed, together with overhead charges, are recovered and credited to this account. The amount of the advance outstanding as at June 30 1991 is $318 536.

Chemistry Centre

The purpose of the advance is to enable the Chemistry Centre to operate a stores function, for purchasing stock items which may relate to unbudgeted contract analytical activities. Recoupment of the advance is the stores portion of the service charged to and collected from clients.

The amount of the advance outstanding as at June 30 1991 is $89 466.

Departmental Receipts in Suspense

This account is used to hold moneys temporarily pending identification of the purpose for which the funds were received. The balance of the account as at June 30 1991 is $1 447.

Notes to and forming part of the Financial Statements for the year ended June 30, 1991

1. Accounting Policy

(a) The Financial Statements are prepared on a cash basis in that only collections received and payments made are reflected therein. The disbursements include a net payment of $770 000 to the Treasury Departmental Receipts in Suspense Account for accrued salaries.

(b) The financial statements included in this report have been prepared in accordance with the provisions of the Financial Administration and Audit Act, 1985.

(c) Comparative expenditure figures for 1989/90 in Table 2 have been prepared on the basis of a 'best estimate' rounded to the nearest thousand dollars. Figures were arrived at by using a combination of actual expenditure specifically relating to the Programs, and a notional allocation based on staffing numbers associated with the Programs. This was necessary as expenditure in 1989/90 was not budgeted nor expended on a Program basis as Program management was not introduced until 1990/91.

(d) Actual expenditure figures for 1990/91 in Table 2 have been prepared by combining transaction data which can be clearly associated with a particular Program, with notional allocations for cost centres which cut across a number of Programs/Sub-Programs as certified by the Divisional Heads concerned. This problem has been resolved for 1991/92 with transaction data directly linked to the Program/Sub-Program of best fit.

(e) All expenditures incurred by the Department of Mines in the provision of services are not appropriated to the Department. The employer's share of superannuation pensions is met by Treasury. Rental of office accommodation is met by the Office of Government Accommodation. Maintenance of Government buildings is met by the Building Management Authority. The servicing of the Department's General Loan and Capital Works Fund debt is met by Treasury.

(f) Property disposals are effected through the State Tender Board and proceeds credited to Revenue Government Property Sales. Exceptions are:

(i) when the original acquisition was met from General Loan and Capital Works Fund the proceeds are credited to Loan Repayment;

(ii) proceeds received from the disposal of Departmental vehicles are credited to general departmental revenue within the Consolidated Revenue Fund.

2. Explanatory Statement

(a) Details of expenditure in advance of appropriation approved in accordance with Section 28 of the Financial Administration and Audit Act, 1985.

(i) Salaries, Wages and Allowances (+$1 739 980)

Supplementary funding of $1 922 000 was approved to cover an inaccurate assessment of funding required for the Department's approved staffing level. However, only $1 739 980 was required as a result of delays in filling vacant positions. The unspent portion of $182 020 was utilised, along with identified savings of $122 866 from other areas, to provide $304 886 for refunds of revenue collected in previous financial years for mining tenements.

(b) Significant variations (greater than 10%) between actual revenues and budget estimates for the financial year.

Territorial Revenue

(i) Petroleum (+ $16 927 106)

Higher petroleum royalty collections resulted from increased oil prices due to the Gulf crisis.

(ii) Mineral Sands (- $6 765 878)

The shortfall in mineral sands royalty collections resulted from a combination of reduced prices, tonnages and sales.

Departmental Revenue

(i) Chemistry Centre (+ $222 968)

Greater revenue collections resulted from increased fees emanating from the Government directive which required the introduction of a revised charging schedule that ensures full recovery of the cost of the services provided.

(ii) Explosives (+ $157 785)

Increased activity levels and tonnage fees collected at Kalgoorlie Explosives Reserves resulted in a higher level of revenue than expected.

(iii) Sale of Motor Vehicles (+ $45 550)

Higher than expected revenue from the sale of motor vehicles was due to greater than anticipated auction prices for vehicles sold.

(iv) Administration (+ $266 658)

The major contributing factor to Administration revenue exceeding the estimate was extra revenue generated as a result of salary recoups for externally funded projects within the Chemistry Centre.

(v) Surveys and Mapping (- $41, 519)

The shortfall in collections in Surveys and Mapping resulted from lower than anticipated map sales, reflecting a general decline in mining activities.

(vi) Engineering (- $10 564)

The shortfall in engineering revenue resulted from a delay in introduction of amended legislation that affected revenue from Mine Management Certificates and a delay in reprinting of Acts and Regulations affected sales.

(vii) Other (+ $69 908)

Additional revenue resulted from the forfeiture of cash securities on two cancelled petroleum permits.

(c) Significant variations (greater than 10%) between actual expenditure and budget estimates for the financial year.

Expenditure on the following Programs was more than 10% above budget, as a result of an inaccurate assessment of funding for salaries, wages and allowances [see Note 2 (a) (i)].

	1990/91		
Program	**Estimate**	**Actual**	**Variance**
No. 3 Environmental Protection and Rehabilitation	1 577 000	1 750 758	173 758
No. 4 Community Benefits	461 000	590 715	129 715
No. 5 Worker & Public Safety	6 171 000	6 984 524	813 524
No. 6 Chemical Services	4 916 000	5 525 245	609 245

(d) Significant variations (greater than 10%) between actual results for the financial year (1990-91) and results for the immediately preceding financial year (1989-90).

(i) Consolidated Revenue Fund Receipts.

Territorial

Total Royalties:

1989-90$	**1990-91$**	**Variance$**
264 221 996	324 411 692	60 189 696

The variance of $60.2 million in royalty receipts was due mainly to an increase in petroleum royalties ($40.7M) as a consequence of higher oil prices and the first full year of collection for the Saladin oilfield and North West Shelf LNG project. Higher royalties were also received from iron ore ($18.4M) and other minerals ($5.7M) resulting from higher sales. These increases were partially offset by a reduction in mineral sand royalties ($4.6M) caused by lower sales volumes and prices.

Departmental

	1989/90$	**1990/91$**	**Variance$**
Sale of Motor Vehicles	728 800	350 550	(378 250)

Reduced revenue for sale of vehicles resulted from the Government's changed replacement policy for 6 cylinder vehicles from 2 years or 40 000 kilometres to 3 years or 60 000 kilometres.

	1989/90$	**1990/91$**	**Variance$**
Administration	403 607	766 658	363 051

Recoups from external organisations for work done by Chemistry Centre staff in 1989/90 were not collected until 1990/91. This was the major reason for the increase in revenue. The remainder was a large number of minor variations.

	1989/90$	**1990/91$**	**Variance$**
Geological Survey	289 144	322 820	33 676

This increase is directly attributable to increases in fees and charges.

	1989/90$	**1990/91$**	**Variance$**
Other	29 839	101 908	72 069

The increase in Other revenue was mainly attributable to forfeiture of petroleum exploration permit cash securities following cancellation.

(ii) Consolidated Revenue Fund Payments

Departmental

Description	**1989/90$**	**1990/91$**	**Variance$**
PROGRAM 1			
Mineral & Petroleum Titles	6 748 000	8 498 257	1 750 257

The increase in expenditure is attributable to refunds of revenue collected in previous financial years. This item was part of Corporate Services in 1989/90 and was reallocated to Program 1 in 1990/91 as this is the Program to which it relates.

Description	**1989/90$**	**1990/91$**	**Variance$**
PROGRAM 3			
Environmental Protection & Rehabilitation	759 000	1 750 758	991 758

The expenditure notionally allocated in 1989/90 was salary only and did not include geological work in National Parks. The actual expenditure in 1990/91 includes salaries of $1 426 000 which includes staff working on the geology of National Parks and contingencies of $325 000.

Description	1989/90$	1990/91$	Variance$
PROGRAM 4			
Community Benefits	3 161 000	590 715	(2 570 285)

The decrease in expenditure is attributable to a one-off royalty refund in 1989/90 to Barrow Island of $2 434 000.

Description	1989/90$	1990/91$	Variance$
PROGRAM 5			
Worker & Public Safety	6 039 000	6 984 524	945 524

The increase in expenditure over 1989/90 is due to additional salaries relating to recruitment of a significant number of mines inspectors to reduce death and injury levels in the industry.

Special Acts

Petroleum (Submerged Lands) Act 1982

1989-90 $	1990-91 $	Variance $
12 204 993	26 940 348	14 735 355

Payments to the Commonwealth in 1990-91 under the Petroleum (Submerged Lands) Act 1982 more than doubled the 1989-90 level as a result of a substantial increase in petroleum royalty collections as outlined under Note 2c(i) above.

3. Supplementary Financial Information

	1989-90 $	1990-91 $
Losses of public monies and public or other property through theft or default	63	5 985
Amount Recovered	-	4 000
Losses for write off	63	1 985
Public and other property, revenue and debts due to the State, written off in accordance with section 45 of the Financial Administration and Audit Act by:		
The Accountable Officer	13 292	5 327
The Minister	1 047	-
	14 339	5 327
Analysis of losses written off		
Stock shortages	10 629	4 269
Bad debts	3 710	1 058
	14 339	5 327
Consolidated Revenue Fund revenues due and uncollected	95 986	170 222
Less considered to be irrecoverable	264	34 609
Amount considered to be recoverable	95 722	135 613
Unpaid expenditure claims as at 30 June 1991 - CRF	110 949	37 817

4. Expenditure by Standard Groups

1989-90		1990-91	
Actual $		Estimate $	Actual $
27 208 434	Salaries, Wages and Allowances	27 332 000	29 071 884
1 738 628	Other Staffing Costs	1 744 000	1 645 815
582 493	Communications	599 000	696 432
6 563 843	Services and Contracts	5 650 000	3 558 881
1 764 875	Consumable Supplies	1 856 000	2 592 666
462 704	Maintenance of Assets	498 000	1 686 415
2 331 289	Purchase of Assets	2 859 000	3 057 977
4 193 751	Grants, Subsidies and Transfer Payments	1 690 000	1 838 850
44 846 017		**42 228 000**	**44 148 920**

The actual expenditure for Services and Contracts, Consumable Supplies and Maintenance of Assets is significantly different to the estimate figures. This does not represent large shifts in expenditure, but rather it reflects a relinking of expenditure types into categories considered by Treasury to be appropriate and in accordance with standardised practice throughout the public sector.

CERTIFICATION OF FINANCIAL STATEMENTS

The accompanying financial statements of the Department of Mines have been prepared in compliance with the provisions of the Financial Administration and Audit Act 1985 from proper accounts and records to present fairly the financial transactions for the year ending June 30, 1991 and the state of affairs as at June 30, 1991.

At the date of signing we are not aware of any circumstances which would render the particulars included in the financial statements misleading or inaccurate.

D R Kelly
ACCOUNTABLE OFFICER

P H Palmer
PRINCIPAL ACCOUNTING OFFICER

DATE 8/10/1991

Opinion of the Auditor General

DEPARTMENT OF MINES

The accounts of the Department of Mines have been audited for the period July 1, 1990 to June 30, 1991 under the provisions of the Financial Administration and Audit Act 1985.

The controls exercised over the recording of property in the asset register were insufficient to adequately identify the Department's assets. In the absence of a properly maintained register it cannot be determined that the assets of the Department have been properly accounted for or that the note to the financial statements relating to losses through theft and default is fairly presented.

In my opinion, subject to the above matter

(i) the controls exercised by the Department of Mines were sufficiently adequate to provide reasonable assurance that the receipt and expenditure of moneys and the acquisition and disposal of property and the incurring of liabilities have been in accordance with legislative provisions; and

(ii) the Statements of Receipts and Payments together with the notes to and forming part of the financial statements are based on proper accounts and present fairly the transactions for the period July 1, 1990 to June 30, 1991.

D D R PEARSON
AUDITOR GENERAL
October 24, 1991

The development of performance indicators is an evolving process which is under constant review.

The task of providing unambiguous indicators is not simple, particularly when they apply to non-commercial situations where community service is involved.

The indicators presented in this report while being meaningful to the Department from an operational point of view, may not always be as meaningful to external authorities.

This year, for the first time, Corporate Programs were put forward as part of the budget process and accepted by Government as the basis on which the Department's resources should be expended.

These authorised programs indicated planned achievements for the year and the information that follows relating to workload indicators and outcomes provides a measure of the Department's performance for the year.

DOLLAR RETURN TO COMMUNITY

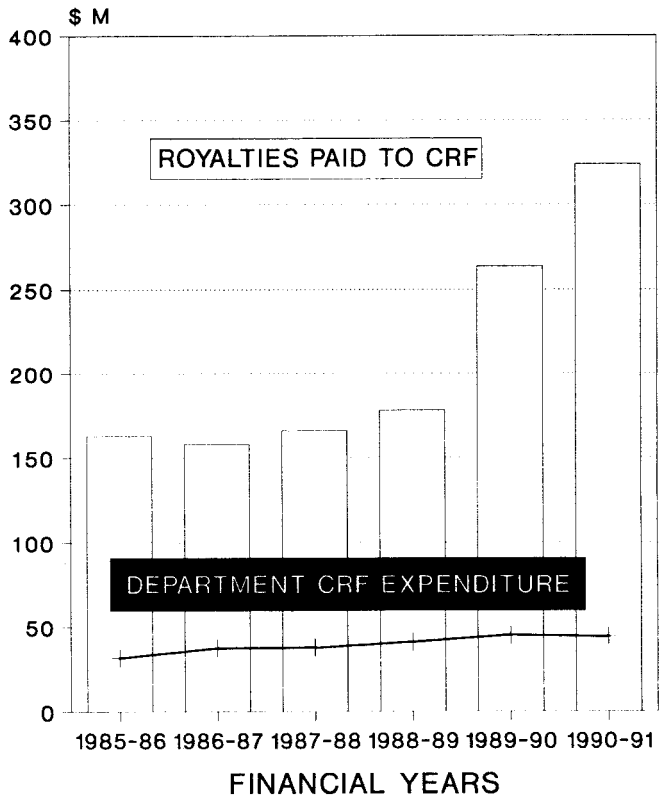


Figure 12

VALUE OF MINERAL PRODUCTION IN W.A.

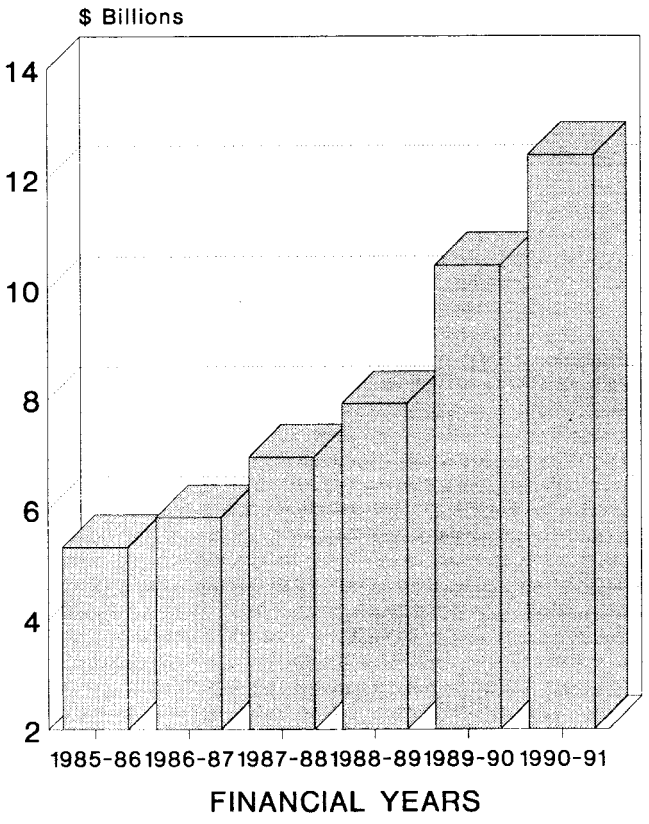


Figure 13

PROGRAM 1: Minerals and Petroleum Titles

To ensure that exploration and development titles for minerals and petroleum are issued fairly and without delay.

Human Resources

Departmental Human Resources Committed to this Program

	1990-91
Geological Survey	7
Mining Registration	*92
Petroleum	5
Surveys and Mapping	61
Total:	165 FTEs

*This figure includes 6.5 FTEs committed to non-Mines Programs. (In the main these are services performed for other Departments at outstations – usually Mining Registrars' offices.)

Workload Indicators

MINING TENEMENTS

Applications Received

	1988-89	1989-90	1990-91
• Prospecting Licences	3 367	2 426	2 720
• Exploration Licences	1 420	1 451	1 285
• Mining Leases	1 243	998	695
Other	367	201	289
Total:	**6 397**	**5 076**	**4 989**
Area applied for (hectares)	**18 574 676**	**17 184 235**	**15 046 424**

Applications Granted

	1988-89	1989-90	1990-91
• Prospecting Licences	2 897	2 202	1 996
• Exploration Licences	916	785	830
• Mining Leases	1 285	1 044	679
Other	349	164	218
Total:	**5 447**	**4 212**	**3 723**
Area granted (hectares)	**11 047 688**	**8 963 752**	**9 344 478**

Tenements in Force

1978 Mining Act	1988-89	1989-90	1990-91
• Prospecting Licences	11 919	7 725	5 517
• Exploration Licences	2 630	2 264	2 183
• Mining Leases & Others	6 636	6 953	6 728
1904 Mining Act:			
• Mineral Claims & Others	507	507	419
Total:	**21 792**	**17 449**	**14 847**
Areas in force (hectares)	**26 278 115**	**22 107 827**	**20 472 186**

Changes to Public Plans

	1988-89	1989-90	1990-91
• Additions	6 404	5 160	4 949
• Removals	10 963	10 273	8 065

Dealings Received

1988-89	1989-90	1990-91
20 481	12 988	14 620

Tenement Surveillance

	1988-89	1989-90	1990-91
• Reports on Operations Received	16 726	11 499	9 580
• Applications for exemption	3 206	3 356	2 744
• Tenements forfeited	1 397	1 317	962

PETROLEUM TENEMENT NUMBERS

Exploration Permits

	1988-89	1989-90	1990-91
Advertised			
Onshore	21	8	All vacant
Offshore	10	17	27
Total:	**31**	**25**	**27+**
Granted			
Onshore	9	5	8
Offshore	8	3	8
Total:	**17**	**8**	**16**
Permits in Force			
Onshore	66	57	49
Offshore	41	42	47
Total:	**107**	**99**	**96**
Production Licences			
Granted	1	1	1
In Force	20	21	23

Performance Indicators

Mapping

If amendments to public plans are not completed within 10 days of receipt at head office, industry is given misleading information on ground available for pegging. This can cause disruption and waste industry resources.

The Department allocates sufficient resources to incoming work to ensure that all tenements are charted within 10 working days of receipt.

An indication of performance is the number processed per FTE to attain the schedule.

The figures for 1989-90 and 1990-91 are shown below:

Tenement Processing

	Quantity	FTE	Number per FTE
•Tenement Charting (other than Exploration Licences)			
1989-90	3 670	3.5	1 050
1990-91	3 673	3.5	1 050
•Tenement Charting (Exploration Licences)			
1989-90	1 490	3.3	450
1990-91	1 276	3.0	425
•Exploration Licence Releases			
1989-90	470	3.0	150
1990-91	492	3.3	149
•Tenement Cancellations			
1989-90	10 270	3.5	2 930
1990-91	8 065	3.3	2 444

Mining Registration

The graphs hereafter illustrate the degree to which applications, dealings and exemptions are registered in accordance with performance criteria set by the Department.

The time criteria have been set to take into account matters such as:

- Statutory review periods set by the Mining Act and the Warden's Court;
- More extensive reviews in cases where land may be subject to control by several agencies; and
- Legal disputation processes.

Applications and dealings received during 1990-91 were within the parameters set for the performance indicators shown.

In the case of exemption applications, a slightly reduced number of receivals together with additional resources allocated to the area saw a doubling of the number of exemptions granted within three months of lodgement over the previous financial year.

The graphs also show the total number of dealing registrations processed each month. The objective of registering 70% of dealings received within one month of lodgement was met and exceeded in eight of the last twelve months.

With the resources available to process mining tenement applications the target of determining 75% of applications within five months of lodgement was not met, but 60% was achieved.

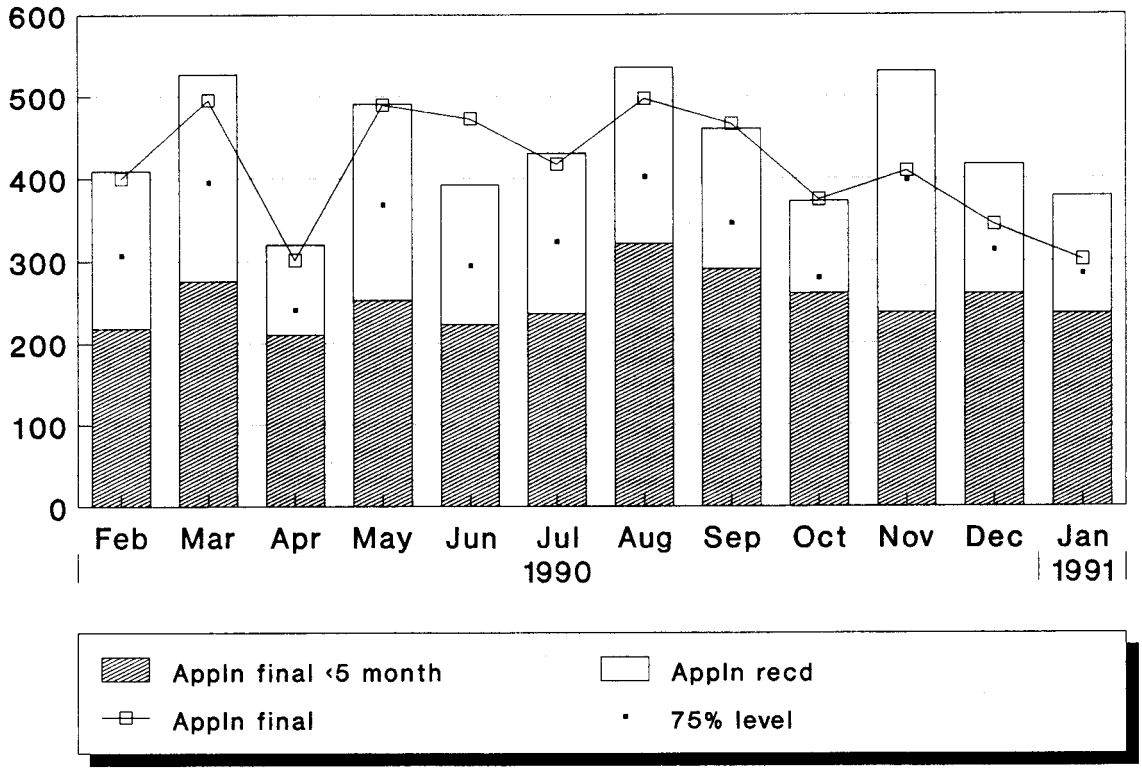


Figure: 14

Mining Tenement Applications and Finalisations February 1990 to January 1991

Indicator: determine 75% of all applications for mining tenements within five months of application.

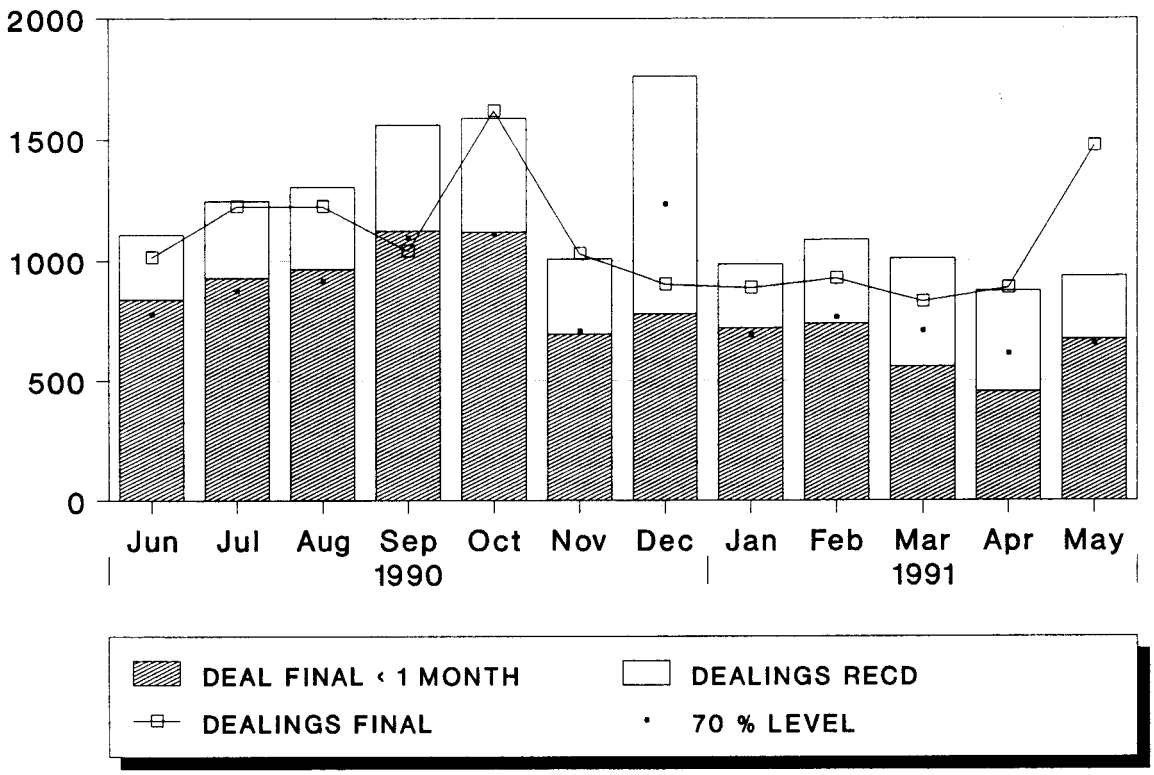


Figure: 15

Mining Tenement Dealings applied for and finalised June 1990 to May 1991.

Indicator: register 70% of all dealings received within one month of lodgement.

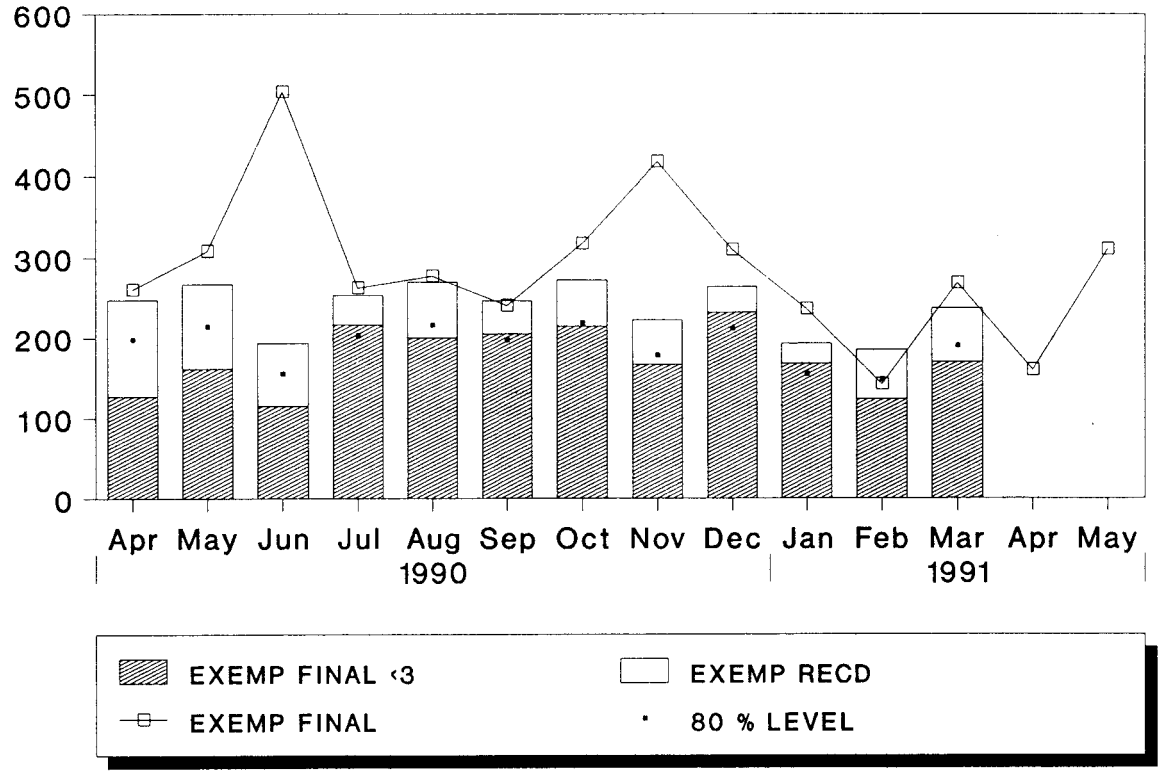


Figure: 16

Exemption Applications received and processed April 1990 to March 1991.

Indicator: determine 80% of exemptions within three months of lodgement.

Planned achievements 1990-91	Outcomes for 1990-91
Clear a backlog of some 2 800 pending applications.	During the year 70% of some 2 800 pending applications were determined. The majority of the applications which remain undetermined are those situated on reserved land and which consequently fall within the scope of the Government's policy entitled "Resolution of Conflict - A Clear Policy for National Parks".
Ensure minimum title revenue is foregone by targetting to process some 75% of applications within five months of lodgement.	60% of all applications were determined within the time frame.
Implement the next phases of an electronic title system — computerised rental and expenditure and data take-up for computer graphics of existing titles.	A computerised system for mining tenement rental and expenditure was fully developed and operated internally during the year and will be progressively implemented for public use in stages during 1991-92. A user requirements study for a tenement graphics system (TENGRAPH) was completed and a strategy developed for data capture and maintenance.
To release the widest possible petroleum areas to attract a greater level of exploration.	In 1990-91 all vacant areas in all sedimentary basins covered by the Petroleum Act 1967 were released. Drilling Reservations were also made available for the first time.
To have objections and disputes heard within three months and maintain the current low level of administrative appeals to the Minister.	In most cases objections and disputes were heard within three months and a low level of administrative appeals to the Minister was maintained.
Implement the first stage of a full user pays system for the survey of mining tenements.	A user pays system for the survey of mining leases will be implemented on 1 July 1991.
Provide for an orderly introduction of the graticular section system for exploration licences.	The graticular section system for exploration licences was introduced on 28 June 1991 after a new map series to support the system was put in place.
Timely review and approval of petroleum seismic, drilling, development and pipeline applications.	Approval of most petroleum operational applications was achieved within one month of receipt. The only approvals taking longer than this were those affected by environmental restraints involving other Government Departments.
To encourage conservation groups and environmental lobbies to express opposition to mining applications through submission rather than formal Warden's Court objection.	There was some reduction in the number of formal objections lodged in Warden's Courts by conservation and environmental lobby groups.

Planned achievements 1990-91	Outcomes for 1990-91
The upgrading of Meekatharra Warden's Court facilities.	During 1990-91 a program was undertaken to upgrade Warden's Court facilities in six of the Department's outstations, including installation of quality recording equipment.
Develop standards and specifications for implementation of GPS surveys for mining tenements.	Three tenement surveys were completed using the Global Positioning System and these will provide the input for the ongoing development of standards and specifications.
Process 450 tenement surveys made up of 150 anticipated new tenements and reduce by 300 the existing backlog of 3 022 surveys.	233 surveys were completed in the year.

PROGRAM 2: Exploration and Development of Natural Resources

To foster and assist responsible mineral and petroleum exploration and development, groundwater assessment, and land-use planning, by providing high-quality scientific and technical services and advice to industry, Government and the public.

Human Resources

Departmental Human Resources Committed to this Program

	1990-91
Chemistry Centre	53
Geological Survey	98
Mining Engineering	17
Petroleum	4
Surveys and Mapping	43
Royalties and Policy Development	11
Total:	226 FTEs

Workload Indicators

	1988-89	1989-90	1990-91
Petrological Examinations			
• Reports compiled	23	29	28
• Samples determined	1 360	539	365
Palaeontological Reports			
• Compiled and issued	16	19	49
Exploration Information Made available to Public			
• Petroleum (reports)	560	407	487
• Minerals (volumes)	819	846	1 411
Groundwater and Stratigraphic Evaluation			
• Metres drilled	9 457	12 997	2 415
Geological Maps Published			
• Major coloured maps	11	11	11
• Other maps	6	7	40
Petroleum Exploration and Development			
• Wells drilled	51	45	76
• Metres drilled	93 411	99 862	135 679
• Seismic Surveys (km)	21 194	30 105	41 543
• Producing Fields	15	18	22
Library Use by Public			
• No. using library	4 087	4 369	5 132
• No. using microfilm readers	1 025	1 203	1 590
Exploration Reports received from Industry			
• Petroleum	383	496	675
• Minerals	3 035	3 165	2 766
Revenue from Sales ($)			
• Maps and Publications	142 713	125 391	162 766
• Microfilm	104 451	99 970	102 684
• Tendex	64 559	58 010	42 881

FOSTER EXPLORATION AND DEVELOPMENT

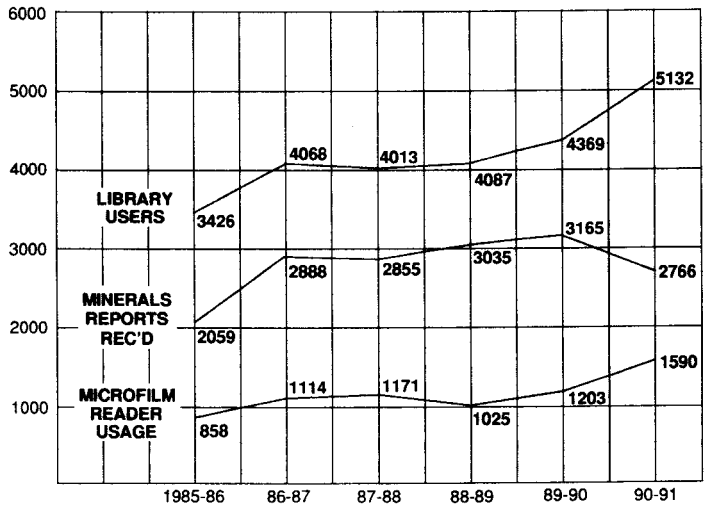


Figure 17

Planned Achievements	Outcomes for 1990-91
Commence practical implementation of the Geoscience Mapping Accord.	Following negotiations with the Bureau of Mineral Resources (BMR) ten joint projects under the terms of the Accord are being conducted in the Eastern Goldfields, King Leopold and Halls Creek Orogens, Paterson Orogen and Canning Basin.
Boost private petroleum company exploration in the Southern Ocean and offshore/onshore Canning Basin, in part by implementing a new onshore acreage release strategy.	Japan National Oil Corporation (JNOC) was encouraged to conduct a speculative seismic survey in the Southern Ocean and as a result this Commonwealth area is to be gazetted for applications in November 1991. Similarly previous surveys by JNOC have been a precursor to the release of offshore Canning areas in April 1991. A new onshore acreage release strategy has resulted in new permits being granted in the onshore Canning Basin.
Increase the output of geoscientific maps to 14; publish geoscientific information for the community and industry including Memoir 3 - The Geology of Western Australia.	Twenty-four publications, including Memoir 3 – "The Geology and Mineral Resources of Western Australia" and 11 maps were published.
Complete experimentation on the regeneration of carbon to maximise the recovery of gold.	Work in conjunction with a commercial manufacturer and supplier of kilns for regenerating carbon used in gold extraction processes was completed and reported by the client at technical meetings in Australia and the USA.
Produce fifty 1:250 000 scale seismic time structure contour maps of the Canning Basin.	Fifty-two 1:250 000 scale seismic time structure contour maps of Canning Basin have been produced; 32 were published, and 20 are awaiting publication. In addition eight similar maps of the Carnarvon Basin were published.
Complete compilation of Esperance 1:1 000 000 geological map, and complete Perth Basin 1:1 000 000 mapping.	Esperance 1:1 000 000 geological map and notes has been compiled. Perth Basin 1:100 000 mapping has been completed and the resulting two maps compiled.
Complete Collie Coalfield and Savory Basin reports.	Draft report on the Collie Coalfield is being technically edited, and the Savory Basin report is in final stages of preparation.
Complete groundwater resources assessments of Collie, Wilga and Boyup basins, Fortescue and Robe coastal plains and palaeodrainages in Eastern Goldfields.	Groundwater resources assessments of Collie, Robe Coastal Plain and Eastern Goldfields have been completed and reports compiled; assessment of the Fortescue Coastal Plain is complete and a report is being prepared. No work was undertaken on the Wilga and Boyup Basins because the officer concerned was required to undertake urgent drought-relief work in the Kimberley.

Planned Achievements	Outcomes for 1990-91
Increased collaboration with CSIRO and tertiary institutions to assist in the improvement of mineral processing and production of advanced materials. A submission for a co-operative Research Centre in Advanced Mineral Processes and Products will be finalised involving CSIRO, Curtin and Murdoch universities and the Chemistry Centre.	The application for a Co-operative Research Centre in Advanced Mineral Processes was unsuccessful in the first round. The application has been considerably strengthened and additional industry support acquired with a view to re-submitting in round 2, closing 3 July 1991.
A column flotation circuit will be commissioned and used to improve processes for the separation of heavy mineral sands.	A column flotation unit was commissioned and data collected on fundamental parameters. MERIWA has agreed to sponsor a research project on the unit with funding from four mining companies.
Develop improved analytical procedures for the quantification of silica in respirable dusts, enabling accurate monitoring of mining and processing environments and provide appropriate advice on safety implications.	An alternative procedure for quantification of silica in respirable dust has been developed. In addition, a new x-ray powder diffractometer has been installed and analytical procedures using this technique are being improved.
Continue to maintain and update geoscience databases.	487 petroleum and 1 411 mineral exploration reports were replaced on open file. Interpretive data from petroleum exploration well-completion reports were made publicly available through a private contractor.
Establish geotechnical databases.	Two geotechnical databases, PERTECH and MINETECH, have been established. Geotechnical databases were established for operating opencut gold mines.
Complete Red Book System 5, and northwest Perth Geographic Information System (GIS) projects in response to customer demand for digital databases.	Red Book System 5 and northwest Perth Geographic Information System projects were completed.
Commence automated geological map production.	Pilot study commenced on the production of multi-coloured geological maps using computer-assisted techniques.
Complete work on Harris River, Manjimup, Waroona, Samson Brook, Little Dandalup, Dirk Brook and Araluen Dams.	Work on Harris River Dam was completed to Water Authority requirements. Work on the other listed damsites was not started due to changes in Water Authority priorities. Work was, however, undertaken on North Dandalup, Conjurunup, Margaret River, and Victoria damsites at the request of Water Authority.

Planned Achievements	Outcomes for 1990-91
Complete work on Carnarvon, Exmouth, Horrocks Beach, Halls Creek and Piawanning town water supplies, and Aboriginal community water supplies.	Work on water supplies for Carnarvon, Exmouth, Horrocks Beach, Halls Creek, and Piawanning was completed to Water Authority requirements. In addition work was also undertaken and completed for the Water Authority on Nullagine, New Norcia, Wellstead, and Watheroo town water supplies. Advice was supplied for Aboriginal community water supplies throughout the State.
Monitor hydrocarbon reservoir drilling results and model petrotechnical parameters to monitor reservoir performance.	All wells drilled through hydrocarbon zones were subject to petrotechnical studies and all petroleum reservoirs are being monitored.
Provide geotechnical and hydrogeological advice to Government agencies as required.	Advice on geotechnical and rock-mechanics matters in relation to mine safety was provided as required to the Mines Inspectorate. Seminars on open-pit stability were held in five Eastern Goldfields centres. Guidelines on bund walls and abandoned open pits were published in January 1991. Research into underground mine design was commenced in February 1991. A drought-relief program in the Kimberley region was planned and supervised for the Department of Agriculture.
Provide advice to the Minister and Government agencies as required.	Advice was provided to the Minister and Government agencies on a wide range of policy, environmental, safety and Aboriginal land-use issues.
Hold seminar on the gazetting of Canning Basin.	The Canning Basin seminar was held in Perth in November 1990 for mineral and petroleum explorers.
Run field excursions to the Bonaparte and Carnarvon basins for industry personnel in connection with the gazetting of these areas.	Field excursions were held in the Bonaparte Basin (June 1990) and Carnarvon Basin (July 1990).
Continue a program of building media awareness and commence a school education program.	Over 500 media enquiries were handled during the year with 85 press releases issued. This level of activity was higher than had been anticipated, and consequently the school education program was not commenced.

PROGRAM 3: Environmental Protection and Rehabilitation

To ensure that proper attention is given to the protection and rehabilitation of the natural environment as it may be affected by mineral and petroleum exploration and development, and to facilitate the protection of groundwater resources.

Human Resources

Departmental Human Resources Committed to this Program	
Mining Engineering	14
Surveys and Mapping	3
Petroleum	1
Geological Survey	8
Chemistry Centre	5
Total:	31 FTEs

Workload Indicators

	1988-89	1989-90	1990-91
Notice of Intent Received for Assessment	126	186	221

Performance Indicators

The trend in improved environmental management for exploration, mining and petroleum projects has continued. Many mining programs now include pre-planning of rock waste dumps to reduce double handling of material and to enable progressive rehabilitation to occur. Many examples of successful rehabilitation programs are evident throughout the State.

The procedures required for the preparation of Notices of Intent (NOI) and annual environmental reports have greatly assisted the current improvements being experienced in the environmental management process.

The success of the NOI process is difficult to quantify in absolute terms, however indicative of our improved performance is the assignment of greater responsibility by the EPA for environmental review and approval of projects.

This performance indicator was further highlighted during the year when the Department received the authority to assess notifications of intention to clear all mining operations under the Soil and Land Conservation Act.

The NOI assessment process utilises advice and recommendations from the EPA and other Government departments such as CALM and the Water Authority.

Two successful prosecutions were instituted for offences under the Mining Act.

Planned Achievements 1990-91	Outcomes for 1990-91
Amendments to the Mining Act 1978 to permit the appointment of inspectors with powers to issue on-the-spot work orders to overcome environmental problems.	The preparation of draft amendments to the Mining Act and associated draft regulations dealing with the appointment of environmental inspectors are proceeding but not yet finalised.
Groundwater investigations in the Perth Basin; pollution investigations in Kwinana\Warnbro\Cockburn Sound; and investigating salinity aspects of bauxite mining in Cameron West catchment area.	Groundwater investigations in the Perth Basin were carried out in the Scott Coastal Plain and Leeman areas. Groundwater pollution investigations in Kwinana\Warnbro\Cockburn Sound area were completed. No work was undertaken in the Cameron West catchment because Alcoa revised its mining development plans.
Production of three State maps showing environmental reserves and capture in digital form four EPA system areas.	Two State maps showing conservation and Aboriginal reserves and a South West regional plan of conservation reserves were complete and are being maintained. The capture in digital format of the conservation areas in four of the EPA system areas in WA and establishment of a database of land tenure and mineral resource data required for analysis of land-use issues in the northern part of the Perth Basin, were achieved.
Completion and maintenance of a computerised system for the monitoring of mining tenements and mineral prospectivity on conservation lands.	A computerised system for the monitoring of mining tenements and mineral prospectivity was completed during the year and is presently being supported and maintained.
Improve efficiency of support to the mining industry by faster turnaround time for analyses and reduction of sample backlogs; transfer newly developed analytical methodology to the private sector.	Support for the mining industry in environmental monitoring has improved in four areas: ■ Turnaround time for cyanide analyses has been reduced to one day (urgent) and one week (routine) by the introduction of new analytical technology; ■ Cyanide speciation methodology is now routine and enables clients to develop a more complete understanding of the fate of cyanide in tailings dams; ■ Turnaround time for full analysis of wastewater samples is now two weeks (down from four weeks in 1990); and ■ The development of new techniques which have increased the Department's cyanide monitoring capability from 20 to 160 analyses per day. The new methodology has been presented at conferences and thus made available to the private sector.
Undertake office studies on Red Book System 1-12 areas.	Office studies on Red Book System 1-12 areas were undertaken as required.

PROGRAM 4: Community Benefits

To ensure that the community receives a fair return from the extraction of the State's mineral and petroleum resources.

Human Resources

Departmental Human Resources Committed to this Program	
Royalties and Policy Development	9

Workload Indicators

Royalties	1988-89 $M	1989-90 $M	1990-91 $M
CRF (Note 1)	176.0	264.2	324.4
Total (Note 2)	195.6	301.8	358.0
State Share	171.9	252.0	297.5
C'weath Share	23.7	49.9	60.5
Value of Mineral and Petroleum Production	7 904.4	10 662.9	12 400.0

Performance Indicators

Fair Return

The Royalties Branch has a key role in seeing that the community benefits from the activities of the mining and petroleum industries.

Important factors in royalty administration are their timely and accurate collection.

The performance of the branch is monitored through the following indicators:

	1990-91 (%)
Royalty received on time (Note 3)	99.9
Royalty audited (Note 4)	76.1
Royalties Finalised (Note 5)	96.3

The branch's efforts to ensure royalties are paid on time has been rewarded with a negligible proportion of late payments. Unfortunately, a number of royalty agreements have not been finalised with petroleum producers and hence the audited proportion is less than desirable. This reflects the complexity and, hence, length of the royalty negotiation process. However, where final arrangements are in place the proportion of payments finalised and audited is a creditable 96.3%

Note 1: Revenue paid into the State Consolidated Revenue Fund (CRF), includes some royalties collected by the Department of Mines on behalf of the Commonwealth for later reimbursement to that Government.

Note 2: Includes all royalties collected from WA projects by either the State or Commonwealth Governments. These are all processed through the Department of Mines WA.

Note 3: Royalty revenues receivable and received on or before the 30 June 1991 as a percentage of total royalty receivable on or before 30 June 1991.

Note 4: Royalty revenue fully audited as a percentage of total royalties receivable.

Note 5: Royalty revenues excluding unpaid royalties and interim royalty receipts as a percentage of total royalties receivable.

Planned Achievements 1990-91	Outcomes for 1990-91
All royalties due to be received on time.	99.9% of the total royalties receivable on or before 30 June 1991 were received in time.
Royalty audits performed in accordance with the audit plan.	76.1% of royalty revenue receivable was audited. The audited percentage was less than desirable as a number of royalty agreements have not been finalised. In respect to finalised agreements the proportion of payments finalised and audited was 96.3%.
Royalty collection systems will be reviewed with emphasis on penalties for non compliance.	Amendments to the Mining Act were gazetted which increased the ability of the Department to collect the correct royalties.
All appeals for royalty relief to be decided on time.	Two appeals for royalty relief were satisfactorily negotiated during the year.
Agreement negotiations for all petroleum operations will be finalised.	No new petroleum royalty agreements were finalised during the year reflecting the difficulty in reaching complex agreements with developers. However, some important long-term issues were satisfactorily resolved.
A comprehensive computerised budget model with detailed variance analysis will be developed.	A revenue forecasting model was developed.
Review royalty legislation in order to provide more economically efficient systems for commodities currently covered by specific rate arrangements.	The review of legislation for specific rate royalties was commenced but not completed during the year.

PROGRAM 5: Worker & Public Safety

To ensure that all operations in the mining and petroleum industry, and activities involving explosives and dangerous goods, are conducted in a manner that is safe for workers and the public.

Human Resources

Departmental Human Resources Committed to this Program.			
Explosives and Dangerous Goods	30	Petroleum	10
Mining Engineering	74	Geological Survey	1
		Total:	115 FTEs

Workload Indicators

	1988-89	1989-90	1990-91
MINING			
Workers	30 332	33 074	35 500
Accidents			
Fatal	16	10	10
Serious	664	615	580
Minor	1 700	1 594	1 600

PETROLEUM
Accident Statistics

	Onshore	Offshore	Onshore	Offshore	Onshore	Offshore
No. in workforce	382	1 345	466	944	429	1 049
No. hours worked (thousands)	949	1 542	819	1 788	940	2 298
Accidents						
Minor	41	18	27	31	26	22
Serious	25	19	2	10	14	8
Fatal	0	0	0	0	1(a)	1(a)
Sub total	66	37	29	41	41	31
Yearly		103		70		72
Total No. manhours lost	11 179	8 408	1 821	5 957	8 844	6 156
Average duration lost-time injuries (hrs)	169.4	227.2	62.8	145.3	215.7(b)	198.6(b)
Lost time injury frequency rate (c)	69.5	24.0	35.4	22.9	43.6	13.5
Lost time injury incidence rate (d)	17.3	2.8	6.2	4.3	9.6	3.0

(a) Fatalities – calculated as 220 day LTI X 12 hour shift. (b) Average duration higher due to fatality hours. (c) Number of accidents x 1 000 000/hours worked. (d) Lost time injuries per 100 people

EXPLOSIVES AND DANGEROUS GOODS

	1988-89	1989-90	1990-91
Licences			
Explosives Licences and Permits	4 076	4 441	4 709
Premises licensed to store flammable liquids	4 623	4 476	4 390
Vehicles licensed to convey dangerous goods	1 715	2 032	2 054
Dangerous goods drivers' licenses	2 969	3 418	4 033
Prosecutions Initiated	22	4	4
Accidents	43	42	44

Worker Safety

Mining

The accident report figures at the end of this section indicate industry performance in the area of safety. The graphical information is compiled for the following:

- Number of injuries per 1 000 workers: Figure 18;
- Fatal Accident rate: Figure 19; and
- Workers' compensation premiums: Figure 20.

Petroleum

The safety performance of the petroleum industry during 1990-91 was assessed using measurement rates recommended in Australian Standard AS1885.1.

The figures indicate that:

- A 3% increase in Lost Time Injuries was recorded compared with the previous year but the number of manhours worked increased by 24%; and
- Offshore operations continue to have a better safety record than onshore operations. This is due to the higher priority placed on safety by operators in the offshore environment compared with onshore. Implementation of the new Schedule of Onshore Exploration and Production Requirements combined with increased surveillance of onshore operations by the Inspectorate should help to redress this problem.

Public Safety

The Explosives and Dangerous Goods Act is concerned with the good management of explosives and dangerous goods through the licensing and inspection of premises where dangerous goods are stored, the method of transport of dangerous goods and the manufacture, storage and transport of explosives.

The outcomes against planned achievements for the year are reported in the section at the end of this program report.

Licensed premises for the storage of dangerous goods

Those premises which generate the most significant risk to public safety were identified and targeted for preferential attention.

The number of priority premises identified in the program was 1 714 and during the course of the year 1 293 of these were inspected. This system greatly improved the allocation of resources.

Dangerous Goods Transport

In association with the program to inspect premises, 852 vehicles without current inspection records were identified.

Of these, 450 were inspected and a further 106 were identified as being inactive and no longer required to be licensed.

During 1990-91 the Department carried out a series of surveys and trial studies to develop indicators to demonstrate the level of compliance with the Dangerous Goods (Road Transport) Regulations. Vehicles which may transport dangerous goods are periodically checked for regulatory compliance in four major areas and within these four areas some 30 individual items are checked.

Six of those items, distributed across the four areas, were chosen ask key indicators of industry performance.

The trial included consideration of:

- Sample sizes (to be not less than 40);
- Sample selection (to maximise randomness); and
- Which indicators to use (these are known only to senior management of the Department so as to avoid compromising the field results).

The results for a sample tested in June 1991 are shown in the column below.

Area	Item	Failures per 100 vehicles June 1991
Documentation	Indicator 1	13.3
	Indicator 2	33.3
Safety Equipment	Indicator 3	33.3
Emergency Response Equipment	Indicator 4	26.7
	Indicator 5	40.0
Vehicle Load	Indicator 6	13.3

Results from similar field trials will be accumulated during 1991-92 and will be used to establish a perform-

ance baseline and to monitor the results of various enforcement strategies.

Explosives

The number of inspections of manufacturing plants, storage facilities and vehicles transporting explosives increased to 529 compared with 514 in 1989-90.

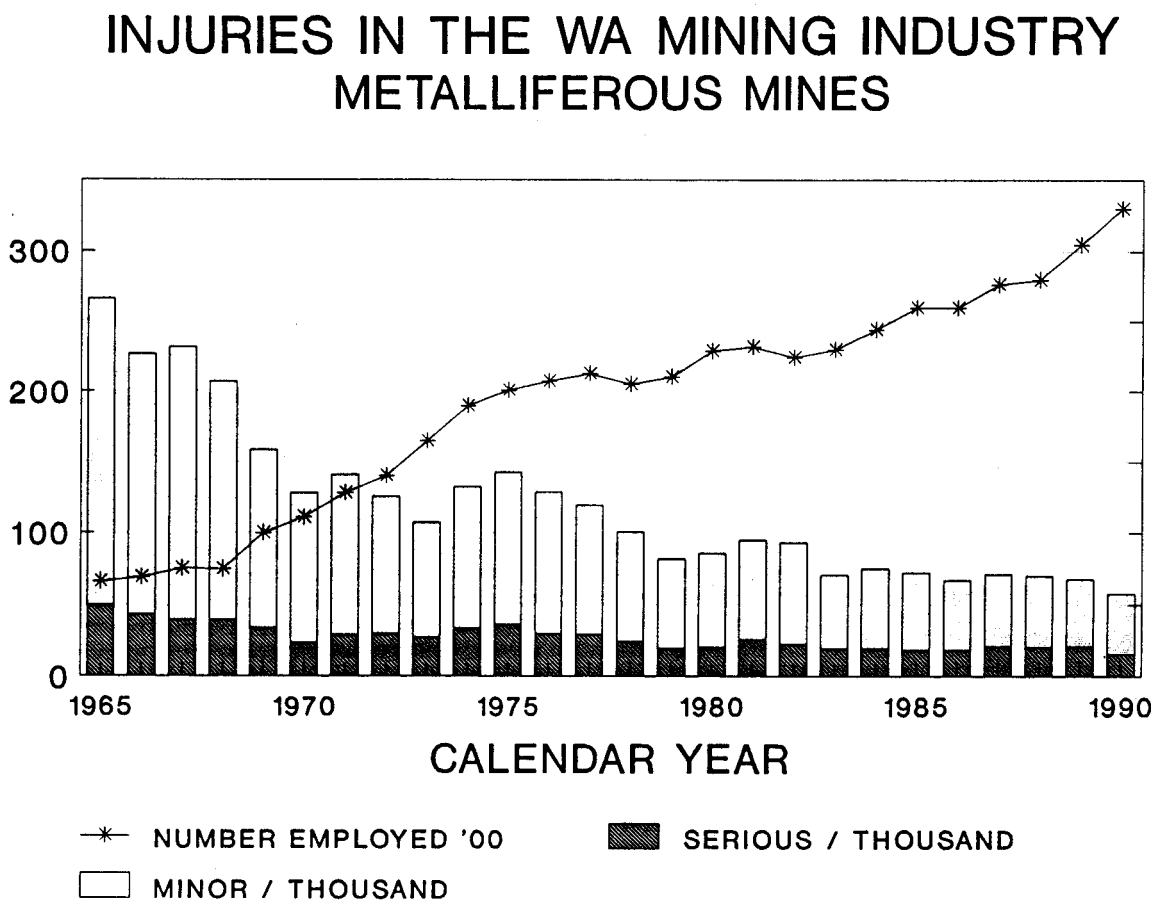


Figure 18

FATALITIES IN THE WA MINING INDUSTRY
METALLIFEROUS AND COAL MINES

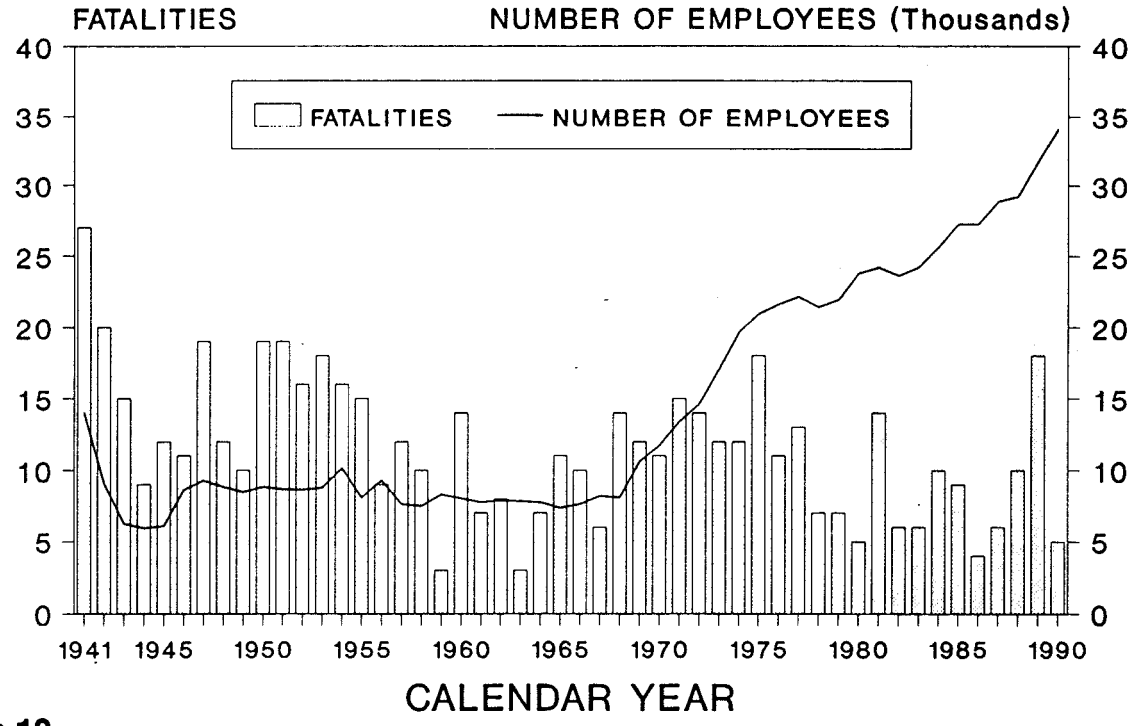


Figure 19

WESTERN AUSTRALIAN MINES
WORKERS COMPENSATION COST TRENDS

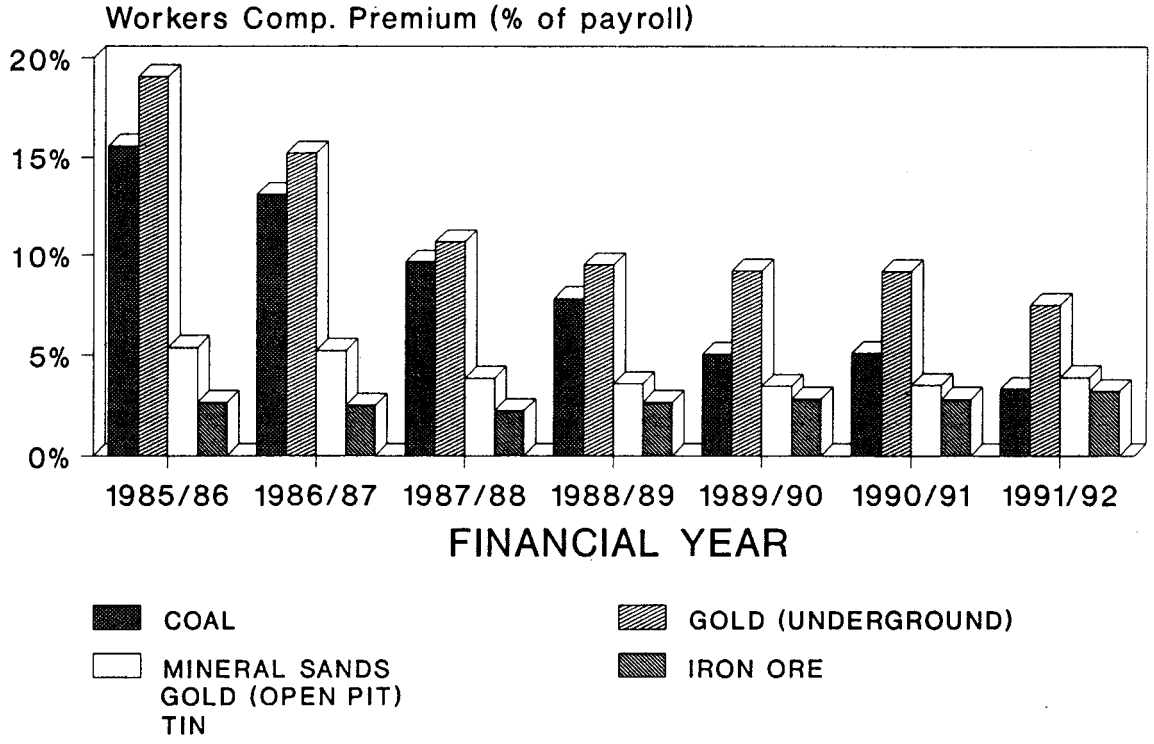


Figure 20

Planned Achievements	Outcomes for 1990-91
Maintain a high level of inspections, advice and communication to further reduce the number of mining and petroleum accidents.	Advice was given to industry on various matters via field seminars and publications. The results for the 1990 calendar year derived from AXTAT showed an across-the-board improvement for the industry of 17% in the incidence rate and 13% in the frequency of accidents. Of particular significance was a 35% improvement in the underground metalliferous sector and a 48% improvement in the coal mining sector. During the year 53 safety field inspections of onshore and offshore production facilities, seismic programs and drilling operations were carried out by the Petroleum Division compared with 45 in the previous year. This reflects the increase in exploration activity and larger number of oil fields in production during this period.
Finalise amendments to the various statutes relating to worker safety.	Key provisions of the Occupational Health Safety and Welfare Act (OHSWA) were incorporated into the Mines Regulation Amendment Act 1990 (No. 85) and a complete revision of the Coal Mines Regulation Act incorporating OHSWA principles was substantially completed.
Have the MIDAS (Mines Dose Assessment System) computer-based radiation exposure recording and reporting system fully operational.	An independent technical audit of the administration of radiation safety in the mineral sands industry endorsed the programs conducted by the Department and the standards achieved in the industry. The computer-based radiation exposure recording and reporting system (Mines Dose Assessment System - MIDAS) has been undergoing field evaluation prior to full commissioning, which is expected to take place in 1991-92.
Participate in the Government's planned inquiry into safety in the mining industry.	The Mining Engineering Division and its Inspectorate has been involved extensively in providing information to and assisting in the conduct of the Enquiry into Safety in the Mining Industry established by the Government.
Complete the development and introduction of the computerised CONTAM 2 system for the recording and assessment of atmospheric contaminants.	The revised CONTAM 2 system for computerised recording and assessment of atmospheric contamination has been accepted and after endorsement of the guidelines by the Ventilation Board will be implemented during 1991-92.

Planned Achievements 1990-91	Outcomes for 1990-91
Maintain a high level of inspection but with considerable emphasis being placed on examining work practices, training programs, emergency preparedness, communication and education in mining operations.	Training courses in occupational health and safety tailored to meet the Mines Regulation Amendment Act 1990 have commenced, prior to the proclamation of that Act. The first stage of a technical study on the long-term stability of open-pit mines was completed.
Implement the recommendations of the 1990 Torlach Safety Inquiry and participate in the planned follow-up Government inquiry into safety in the gold mining industry.	Implementation of recommendations of the 1990 Torlach Safety Inquiry continued throughout the year and in the gold/nickel mining sector, induction and training has been revised, improved and extended.
Implement new safety and occupational health directions associated with onshore petroleum exploration and production and the construction and operation of pipelines.	In conjunction with industry and other interested parties the new Schedule of Onshore Exploration and Production Requirements was finalised, resulting in regulated design, construction and operations of petroleum pipelines.
Increase the number of inspections of licensed premises and vehicles by ensuring optimum application of inspection resources.	During 1990-91 there was a total of 3 483 inspections conducted at premises where dangerous goods are stored. There were 1 347 inspections of vehicles licensed to transport dangerous goods in bulk during the year. This represents an increase of 568 inspections and accounts for 65.9% of the total number of vehicles recorded on the licence database.
Promulgate and implement comprehensive dangerous goods storage regulations based on National codes.	The draft dangerous goods storage regulations based on National codes were received from Parliamentary Counsel, reviewed and returned for final amendments.
Implement of plans to devolve selected inspectoral duties to third party inspectors while maintaining an auditing role.	Four fabricators and tank manufacturers have been audited and accredited to carry out pressure tests and similar maintenance work.

PROGRAM 6: Chemical Services

To enhance agricultural and industrial development and the protection of community, consumer, environmental and health standards, by providing high-quality independent chemical services to Government, industry and the public.

Human Resources

Departmental Human Resources Committed to this Program

Chemistry Centre 96 FTEs.

Peformance Indicators

The key elements determining the Chemistry Centre's effectiveness are:

- Quality;
- Resource allocation; and
- Time.

Quality

The quality of Chemistry Centre data and advice can be assessed by the effectiveness of its quality assurance programs. The Chemistry Centre is NATA registered for over 100 chemical test areas and up to 70 different determinations within an area.

During 1990-91, the Chemistry Centre participated in inter-laboratory proficiency trials in the following areas:

- Water analysis for a range of inorganic components;
- Pesticide residues in fats;
- Illicit drugs identification;
- Blood alcohol levels and sobriety drug screening;
- Physical evidence exhibits;
- Metals and other components in foodstuffs and blood;
- Performance enhancing drugs in animal specimens;
- Plant materials for a range of components;
- Solvent extracts for polynuclear aromatic hydrocarbons; and
- Toxicological screening for drugs in biological specimens

Resources

During 1990-91, all CRF-funded clients were provided with costing details of their work with each report. In addition, client Departmental executives were provided with monthly summaries of the costs incurred by Chemistry Centre services. These non-chargeable Chemistry Centre costs were calculated on a full cost recovery basis.

The information provided to Government clients has allowed agencies to assess the cost of chemical services essential to the progress of their own programs.

Time

The timeliness of provision of results and advice is critical to clients for successful progress of their programs.

Laboratory management systems which will permit better control over turnaround times are planned as part of the Information Technology Plan. This plan was not funded in 1990-91 but progress has been made in some laboratories towards implementation of automated laboratory management systems.

Turnaround time for post-mortem toxicological screening has been reduced from 10 weeks to four weeks, primarily as a result of four additional staff approved by Cabinet.

Turnaround time for cyanide monitoring for the mining industry has been halved due to development methodology.

Planned Achievements 1990-91	Outcomes for 1990-91
Increase quality assurance in all laboratories and increase range of tests accredited by NATA.	The Environmental Chemistry Laboratory, Health Chemistry Laboratory and Materials Science Laboratory were all re-accredited by NATA during the year. The Racing Chemistry Laboratory has completed the first stage of the registration and accreditation process. All laboratories now have laboratory operations manuals, methods manuals and safety manuals as required by NATA.
Implement scheme to advise Government clients of the full cost of providing Chemistry Centre services.	All Government clients have been notified of the full costs of providing services since 1 July 1990.
The forward estimate of sample receivals for 1990-91 arrived at in consultation with the Department of Agriculture and others is 57 000. It is planned to complete at least this number and also to make further reductions to the backlog which stands at 16 481 at 1 July 1990.	Sample receivals from the Department of Agriculture (and others) into the Agricultural Chemistry Laboratory was 59 000. The backlog stood at 21 290 at 30 June 1991, up from the figure at 30 June 1990, due principally to equipment problems with auto-analysers.
Applications for research grants in the Agricultural Chemistry Laboratory for 1990-91 total $440 000.	Research grant applications approved for funding in the Agricultural Chemistry Laboratory for 1990-91 totalled $407 000.
Undertake a larger, better planned survey of pesticide contamination of mothers' milk. Liaison with Health Department in developing a 120 sample trial.	A survey of 130 nursing mothers for pesticide residue levels in breastmilk was completed for the Health Department.
Liaise with pollution control officers of the EPA to develop more reliable techniques for atmospheric pollution investigation.	Liaison with the Pollution Control Division of the Environmental Protection Authority has resulted in plans to investigate the quality of Perth's urban, residential and central business district's atmospheric environment. Some work has been undertaken in the Kwinana area and a sampling program has commenced in the Perth city area.
Develop jointly with the EPA and Waterways Commission efficient and integrated analytical services for monitoring of water bodies for nutrient pollution.	The joint EPA/Waterways Commission nutrient laboratory at 57 Murray Street, Perth, is now working effectively as part of the Chemistry Centre operations. This has ensured efficient use of staff and equipment to provide a timely nutrient analytical service.
Co-operate with Health and Agriculture departments to ensure adequate and efficient monitoring of foodstuffs for pesticide contamination. Fruit and vegetable surveys to be increased to one species per week as soon as resources will permit.	As part of the Western Australian Food Monitoring Program, the fruit and vegetable analytical surveys for pesticide residues has continued jointly with the Health Department. A report issued in late 1990 indicated that in 179 separate samples of fruit and vegetables tested for 29 contaminants, approximately 2% contained pesticides at levels above the maximum residue limit.

Planned Achievements 1990-91	Outcomes for 1990-91
Appoint and train the increased Forensic Science Laboratory staff establishment approved by Government.	Forensic Science Laboratory staffing levels were increased to 20 as the result of a Cabinet decision. The new staff are now appointed and being trained to ensure client requirements are met.
Decrease response time of coronial cases from seven weeks to four weeks.	The response time for coronial cases has been reduced from seven weeks to four weeks.
Undertake a major survey jointly with the Health Department to determine levels of preservatives in local foods, in response to community health concerns.	A joint report with the Health Department and Local Government into levels of monosodium glutamate in foods was released in August 1990. This work covered sampling of 197 restaurant meals and 53 brands of packaged food and revealed that 99.5% of samples had MSG levels within normal levels. A joint survey with the Health Department into levels of preservatives in foods has begun. Levels of sulphur dioxide in imported foods have been established.
Increase the range of organic metabolites being determined for assessment of workplace and community exposure to chemicals.	Developments to increase the range of organic metabolites for assessment of workplace exposure to chemicals was deferred to give priority to the development of new techniques for determining toxic atmospheric organic chemicals such as isocyanates.
Continue the development of new analytical techniques necessary to verify composition claims of new explosives being introduced into the State.	Further development of analytical techniques for new explosives was discontinued following amended priorities of the requesting authorities.
Increase activity in investigation of corrosion and metals failure.	Work in corrosion investigations is increasing and a major project concerning the corrosion resistance of friction rock stabilisers used in mines has been developed.
Continue efforts to increase the range of drugs investigated in each sample submitted by the racing bodies.	The continued detection of a range of drugs in the racing industry justifies the efforts expended in development of improved methodology for identification of a wider range of drugs at trace levels.

CERTIFICATE OF PERFORMANCE INDICATORS

I hereby certify that these performance indicators are based on proper records and fairly represent the performance of the Department of Mines for the year ending June 30, 1991.

D R Kelly
ACCOUNTABLE OFFICER

14.8.91

Opinion of the Auditor General

DEPARTMENT OF MINES
PERFORMANCE INDICATORS 1990-91

The performance indicators of the Department of Mines have been submitted for audit under section 63 of the Financial Administration and Audit Act 1985, but have not been audited.

As detailed in the August 31, 1989 Report of the Auditor General to Parliament, the stage has yet to be reached where it is possible to conduct an audit of performance indicators as required by the legislation. I am therefore not in a position to, and do not, express an opinion on the performance indicators of the Department of Mines for the period July 1, 1990 to June 30, 1991.

D D R PEARSON
AUDITOR GENERAL
October 24, 1991

Appendix 1: Legislation

The Department is responsible to the Minister for Mines for the administration of 17 individual Acts of Parliament.

Principal Acts

Mining Act
Petroleum Act

Other Acts

Coal Mines Regulation Act
Coal Miners' Welfare Act
Explosives and Dangerous Goods Act
Mines Regulation Act
Mine Workers' Relief Act
Miners' Phthisis Act
Mining on Private Property Act
Petroleum Pipelines Act
Petroleum (Registration Fees) Act
Petroleum (Submerged Lands) Act
Petroleum (Submerged Lands) Registration Fees Act
Western Australian Coal Industry Tribunal Act

The following Commonwealth legislation is administered in the Western Australian adjacent area by the State and through the Commonwealth/Western Australian Offshore Petroleum Joint Authorities:

Commonwealth Petroleum (Submerged Lands) Act
Commonwealth Petroleum (Submerged Lands) (Registration Fees) Act
Commonwealth Petroleum (Submerged Lands) (Royalty) Act
Commonwealth Petroleum (Submerged Lands) (Retention Lease Fees) Act
Commonwealth Petroleum (Submerged Lands) (Exploration Permit Fees) Act
Commonwealth Petroleum (Submerged Lands) (Production Licence Fees) Act
Commonwealth Petroleum (Submerged Lands) (Pipeline Licence Fees) Act
Commonwealth Minerals (Submerged Lands) (Registration Fees) Act 1981
Commonwealth Minerals (Submerged Lands) (Works Authority Fees) Act 1981
Commonwealth Minerals (Submerged Lands) (Production Licence Fees) Act 1981
Commonwealth Minerals (Submerged Lands) (Exploration Permit Fees) Act 1981
Commonwealth Minerals (Submerged Lands) (Royalty) Act 1981

In addition to its responsibilities under the above Acts, the Department undertakes various functions in relation to a number of special Agreement Acts:

Barrow Island Royalty Trust Account Act
Barrow Island Royalty Variation Agreement Act
Mining (Validation and Amendment) Act.

The following Acts previously administered by the Department are now administered by the Coal Industry Superannuation Board:

Coal Industry Superannuation Act 1989
Coal Mining Industry Long Service Leave Act.

Appendix 2: Changes to Legislation

Mines Regulation Act 1946 and Regulations

The Mines Regulation Amendment Regulations 1991 were gazetted on 15 February 1991. These regulations amended Part 9 of the Mines Regulation Act, which encompasses protection of miners against noise induced hearing losses.

The Mines Regulation Act, Regulation 2.7 was repealed on 15 March 1991 abolishing the District Inspectors of Mines Selection Committee.

Coal Mines Regulations

The Coal Mines Amendment Regulations 1991, Regulation 21 was amended on 21 June 1991 to increase the fee for management certificates .

Petroleum Act 1967

Petroleum (Registration Fees) Act 1967

WA Petroleum (Submerged Lands) Act 1982

WA Petroleum (Submerged Lands) Registration Fees Act

Petroleum Pipelines Act 1969

Act Amendment (Petroleum) Act

Petroleum Registration Fees Amendment Act

Petroleum (Submerged Lands) Registration Fees Amendment Act

Petroleum Amendment Regulations 1990

Gazetted 28/9/90 and proclaimed to commence 1/10/90

These amendments generally reflect amendments made to the Commonwealth Petroleum (Submerged Lands) Act, 1967 to preserve the common mining code envisaged by the 1979 Offshore Constitutional Settlement between the Commonwealth and the States, but modified to make good various discrepancies and additional improvements. The following changes were made:

- Provision for explorers to retain tenure over presently noncommercial discoveries by way of retention leases;
- Streamlining of the registration procedures for legal documents;
- Clarification of the the extension and scope of access and special prospecting authorities to facilitate increased seismic acquisition;
- Provision for earlier release of basic data and interpretive information supplied by title holders;
- Provision for the service of documents on two or more title holders to be made to a common address;
- Provision for production of petroleum to occur through a surface installation outside a production licence by way of a deviated well;
- Nomination of blocks as a location (the forerunner of a production licence or retention lease) to conform to the boundaries of a field rather than the present artificial nine block square;
- Peripheral facilities, particularly of a minor processing nature, being adopted into an onshore pipeline;
- Pipelines in the internal water areas of the State (including all of the Barrow Island loading line) being brought under the jurisdication of the Petroleum (Submerged Lands) Act of WA; and
- The "Crown Land" definition in the Petroleum Act being expanded to align with the Crown Land definition under the Mining Act.

Petroleum Act 1967

Petroleum (Drilling Reservations) Amendment Act 1990

Gazetted 22/2/91 & proclaimed 19/2/91 to commence 1/3/91
Amends Petroleum Act 1967 to allow the grant and administration of drilling reservation titles.

Petroleum Amendment Regulations 1991

Gazetted and effective 28/6/91.
Add Drilling Reservation fees and amend forms to mirror and reflect the same fees prescribed for Petroleum Exploration Permit.

Commonwealth Petroleum (Submerged Lands) Act 1967

Commonwealth Petroleum (Submerged Lands) (Royalty) Act 1967

Petroleum (Submerged Lands) Amendment Act 1991

Petroleum (Submerged Lands) (Royalty) Amendment Act 1991

Commenced on 25/6/91

Provides for the delegation of routine Joint Authority powers jointly to Commonwealth and State officials.

Clarification of the basis for royalty transfers between Commonwealth and Western Australia.

Extension of the period of confidentiality for basic "speculative" survey data up to five years at the designated Authority's discretion.

Explosives and Dangerous Goods Act 1961

Explosives and Dangerous Goods (Third Schedule) Amendment Order 1990

This amendment to the Third Schedule to the Act was necessary to correct a deficiency in the classification of flammable liquids and to include some substances in the Poisons Act as Chronic Hazardous Substances.

The amendment also saw a changeover to the alphabetical classification system for Restricted Dangerous Goods.

Explosives and Dangerous Goods (Classification of Dangerous Goods) Amendment Order 1990.

This amendment was required to declare particular substances to be dangerous goods and to classify those substances by reference to the system specified in the Third Schedule to the Act.

Explosives and Dangerous Goods Amendment Act 1990

This amendment Act was assented to on 27 September 1990 and proclaimed on 23 November 1990.

Many of the changes detailed in the Bill were necessary for the implementation of the requirements of the Public Safety Sub-Committee through the Dangerous Goods Regulations.

Other changes included an increase in the penalty provisions of the Act and streamlining of some of the general administrative processes.

Mining Amendment Act 1990 (No.22/90)

This Amendment Act was proclaimed to operate from June 28, 1991. The major highlights of these amendments are:

- Graticular System for Exploration Licences

This system provides for exploration licences to have boundaries defined by lines of predetermined latitudes and longitudes, one minute by one minute. Each one minute block has its own identification number.

The boundaries of exploration licences are now described using this system and up to 70 blocks may be applied for.

- New provisions relating to mining tenements over townsites

New Section 26A allows the Minister for Mines to request the holder of a tenement over a townsite to surrender the surface (up to 15 metres) of part or all of the tenement for community purposes if the surrender is not lodged within 30 days, the land is deemed surrendered.

- Conditions for prevention or reduction of injury to land

New Sections 46A and 63AA allow reasonable environmental conditions to be imposed on prospecting and exploration licences at any time to ensure maximum environmental protection allowable should circumstances change.

- Surrender of certain areas subject to the exploration licence

Section 65 has been amended to clearly state that a surrender under this section must be lodged on or before the expiry of the third or fourth year of the licence term.

- Miscellaneous licences

New Sections 94A and 94B allow for mining tenements to be applied for and granted over land the subject of a miscellaneous licence.

- Exemption from expenditure conditions

An application for exemption may now be lodged during the year to which the expenditure relates or within 60 days thereafter. The same period that applies to the lodgement of the Form 5 "Report on Operations".

- Verification of royalties payable

Section 109A was inserted to enable the Minister for Mines to make an estimate of royalty where royalty has not been paid, or was not properly assessed or calculated, and to accept audit certificates as verifying royalty. It also allows for the production and inspection of records relating to the verification of royalties and includes penalties for persons failing to supply the information required to enable assessment of royalties.

- Increase of various monetary penalties

Monetary penalties relating to breach of tenement covenants or conditions and various offences have been substantially increased to act as a deterrent and to provide a meaningful alternative to forfeiture of a tenement where that is provided for.

Mining Act 1978 Regulations

(a) Mining Amendment Regulations (N0. 4) 1990, gazetted November 16, 1990.

To provide for new marking out procedures.

Mining Amendment Regulations 1991, gazetted May 31, 1991 to operate from June 28, 1991.

These regulations support the graticular section system for exploration licence boundaries contained in the Mining Amendment Act 1990 (No. 22.90).

Mining Amendment Regulations (No. 2) 1991, gazetted May 24, 1991.

Includes "meteorological station" and "sulphur dioxide monitoring station" as prescribed purposes for which a miscellaneous licence can be applied for.

Mining Amendment Regulations (No. 3) 1991, gazetted June 21, 1991 to operate from July 1, 1991.

To provide for a user pays survey system for leases.

Appendix 3: Research and Development Projects

Chemistry Centre (WA)

Commenced and Continuing

Alkaloid Content in Lupin Plants.

Alkaloid Levels in Commercial Lupinseed.

Alkaloids and Protein in Lupin Breeding Samples.

Purification of Lupin Alkaloids.

Arsenic Contamination of Wool.

Cadmium in Vegetables.

Non Wetting soils Cause of Hydrophobicity.

Vasse Wonnerup Soil Survey.

Vegetable Production and Water Pollution.

An Investigation of Salt Induced Stains of Swimming Pools.

The Causes of Corrosion in a Hospital Calorifier.

Efficacy Assessment of Two Swimming Pool Algicides.

Causes of Corrosion in a Large Hospital Chilled Water System.

Determination of Radon in Waters.

Joint Investigation With Health Department into Organochlorine Pesticide Residues in Human Breast Milk. (Series 2).

Survey of Pesticide Residues in Fruit and Vegetable Marketed in Western Australia.

Investigation of Pesticide Contamination of Fish in the Swan River.

Investigation into the Effect of Air Conditioner Cooling Water Discharges from the Central Business District, Perth, WA, on the Swan River.

A Survey (with Health Department) of Metropolitan Perth Tip Leachate Contamination of Groundwater.

A Joint Investigation with Environmental Protection Authority in the Quality of the Perth Atmospheric Environment with Respect to Hydrocarbon Contamination.

Synthesis of Deuterated Pethidine and Norpethidine.

Extraction and Analysis of Salbutamol.

Screening of Basic Drugs by Photodiode Array/HPLC.

Blood Alcohol Concentration of Preserved Versus Non Preserved Post Mortem Bloods.

Fluoride Levels in Post Mortem Bloods.

Solid Phase Extraction of Drugs.

Determination of B-Blockers by GC/MS Using Boronic Acid Derivatisation.

Screening of Benzodiazepines by Photodiode Array/HPLC.

Brass Particle Analysis.

Organic Pigment Identification in Automotive Paints.

Characterisation of Metallic Detonator Fragments.

Characterisation of Lipsticks by Pyrolysis Technique.

Alcohol Metabolism Studies.

Comparison of Microscopic Toolmarks by SEM.

Survey of Waste Anaesthetic Gases in Western Australian Hospitals.

Feasibility Study of a New Face Mask for Scavenging Waste Anaesthetic Gases from Recovery Patients.

Method for the Determination of Oxalates in Air.

Feasibility Study on Microwave Digestion on Biological Materials for Arsenic Determinations.

Development of Isocyanate Method and Survey for Industries.

Method for the Determination of Patulin in Apple Juice.

Survey of Lead in Wine Crystal Glasses.

Testing the Calibration of Hydrogen Cyanide Monitors Using Standard Gas Concentrations.

Method (Colorimetric) for the Determination of Cyanide in Blood

The Effects of Storage Time on the Concentrations of Additives in Meat.

Mercury in Western Australian Shark.

Mycotoxins: A Preliminary Report.

Sulphur Dioxide in Western Australian Foods.

Cadmium in Potatoes.

MERIWA Project: Studies on the Column Flotation Characteristics of Oxide and Sulphide Ores.

Comparative Study of Gold Assays in Complex Sulphide Materials by Fire Assay and Aqua Regia Digest/AAS.

Effect of Wetting and Oxidizing Agents on Heap Leaching of Gold Ores.

Comparison of XRD and FTIR Methods of Quartz Dust Analysing Using Direct and Indirect Sample Preparation.

Quantitation of Respirable Silica by FTIR Spectroscopy.

Analysis of Historical Leather by FTIR Spectroscopy.

AMIRA project: Fate of Cyanide near Mine Tailings Involving Speciation and Quantification of Metal Cyanide Complexes.

Automated Gold Search Routine Using the Scanning Electron Microscope.

Modified Bond Work Index Procedure.

Calcium Fouling of Activated Carbon used for Gold Recovery.

Pressure Oxidation of Stibnite to Enhance Gold Extraction.

NPDP Sponsored Project: On Line Metal Analyser for Mineral Processing (Jointly with Chemtronics Ltd).

Carbon Attrition in Pulp Method Development.

Grefco Filtration Standard Method for Diatomite.

Friability of Ilmenite During Upgrading.

The Determination of Selenium in Gold Bullion by ETA. AAS.

The Speciation of Silicon and Quantification by XRF's.

Furnace Efficiency Studies on the Electronic Carbon Arc Silicon Smelter: Joint Project with SIMCOA and Curtin University.

Characterisation of Silica Fume By-product from the Silicon Smelter : Joint Project with SIMCOA and Curtin University.

Petrogenesis of Stratiform Barite : Joint Project with Geological Survey (WA).

Mineralogy, Mineral Chemistry and Geochemistry of Gold Bearing "Sulphide Facies Iron Formation" : Joint Project with Geological Survey (WA).

Mineralogy of Oxidised Green Leader and other Telluride Iodes.

Featurescan Software Development to Automatically Quantitate Low-level Gold in Stibnite Concentrates.

Software Development to Automatically Characterise the Size of Airborne Dust in the Mineral Sands Industry : Joint Project with Mining Engineering Division.

The Development of an on-line Hydride Generation Device for ICP-AES.

Detection of Corticosteroids by GC-MS.

Detection of Anabolic Steroid Metabolites in Greyhounds.

Completed

Installation and Commissioning of a Inductively Coupled Plasma Atomic Emission Spectometer. (External Funding for half cost).

Installation and Commissioning of Leco Nitrogen Determinator. (Externally Funded)

Installation and Commissioning Graphite Furnace Atomic Absorption Spectrometer

Ionic Strength of Western Australian Soils.

Alkaloid Profiles in Lupinus Species.

Soil Test Subsoil Aluminium Extractable in .005M KC1.

Investigation and Minimisation of Corrosion Factors Associated with the Southern Cross Fountains (Narrows Interchange).

The Determination of Copper at Trace Concentration in Petrol.

The Determination of Aluminium at Ultratrace Concentrations in Water.

Survey of Inorganic Constituents in 60 Commercially Available Mineral Waters.

Investigation into the Agriculture Protection Board's Fenithrothion/Locust Control Program.

Joint Investigation with the Health Department into Organochlorine Pesticide Residues in Human Breast Milk.

An Investigation into Tailings Management Practices at a Gold Mine Site in South Western Australia.

An Investigation into Residue Disposal Practices at an Aluminium Smelting Plant at Port Henry, Victoria.

Two major surveys of Groundwater Quality for Organic Chemical Contamination (Jointly with WAWA).

Blood Alcohol Management System.

Screening of Acidic and Neutral Drugs by HPLC.

Deuterated Standards in Drug Analysis.

Automatic Gunshot Residue Particle Analysis.

Forensic Applications of Simultaneous Pyrolysis/Alkylation.

Development of a Fuel Cell Powered Breath Analyser Device.

Selection of Containers for the Storage of Organochlorine Pesticides in Blood.

Effectiveness of a Fume Cupboard with a New Filter System.

Feasibility Study of a Recirculating Prototype Fumecupboard for Usage in Western Australian Schools.

Study of the Effectiveness of a New Scrubbing System for Fumecupboards at Tiwest, Kwinana.

With Health Department, set up Standard Criteria for Procedures in Hospital X-ray Photograph Laboratories involving Chemicals.

Method for the Determination of Lead in Blood by GFAA.

Method for the Determination of Thallium in Urine by GFAA.

Method for the Determination of Selenium in Blood.

Method for the Determination of Cyanide in Blood by HPLC.

Method for the Determination of Mercury in Charcoal Tubes.

Method for the Determination of Arsenic in Blood and Urines.

Heap Leaching Characteristics of Western Australian Gold Ores.

Separation of Arsenopyrite and Pyrite from Harbour Lights Gold Mines Concentrates.

Bubble Size Measurements in Two and Three Phase Systems in Column Flotation.

Ferric Chloride Leaching Characteristics of Copper Concentrates.

Photodegradable Shopping Bags.

Photodegradable Polyethylenes (Student project)

Silicon Based Polymers from Silica Fume - Student project.

High Purity Silica from Silica Fume - Student project.

Determination of Active Xanthate.

The Effect of Water Temperature and Water Hardness on Flotation of Mt Weld Phosphate Ore (Jointly with CSIRO).

The Determination of Trace Level Impurities in Platinum Metal by ICP-AES.

The Development of a Simple on-line Dilution Device for ICP-AES.

The Quantitative Retention of Sulfur in a Lithuim/lanthanum Borate Flux for XRFs Analysis.

Explosives and Dangerous Goods

Completed, or not requiring Total Hazard Control Plans

Liquid Air Separation Plant and associated storage of cryogenic gases, Kwinana.

Kemerton Buffer Zone Study

Completed to Third Party Audit and under review

Tiwest Titanium Oxide Plant, Kwinana.

SCM Titanium Dioxide Plant, Kemerton.

Nufarm-Coogee Chlorine Plant, Kwinana.

CSBP Ammonia Storage Facility, Kwinana.

CSBP Sodium Cyanide Plant, Kwinana.

Awaiting development of Total Hazard Control plan

BP Petroleum Refinery, Kwinana.

WMC Nickel Refinery, Kwinana.

Nufarm Chlorine Plant, Kemerton.

CSBP Chlorine Plant, Kwinana.

First Annual Audit completed and under review

Wesfarmers' LPG Plant, Kwinana.

Woodside LNG Plant.

Geological Survey

Most of the work of the Geological Survey Division is involved in research and development projects to investigate, interpret and record the geology of Western Australia; relate the mineral, petroleum and groundwater occurrences and potential to that geology; and evaluate the mineral, fossil fuels and groundwater resources of the State. For a full listing of current and proposed projects see "Record 1990-91 Summary of Progress of the Geological Survey of Western Australia during 1989 and plans for 1990 to 1994-95". Some of the highlights of the program are:

Pilbara Craton geological mapping

King Leopold and Halls Creek Orogens geological mapping

Geoscientific investigations in the Eastern Goldfields region

Paterson Orogen geological mapping

Jurassic sequences of the southern North West Shelf

Basin studies in the northern Perth Basin

Seismic-horizon mapping in Phanerozoic basins

Perth Basin groundwater susceptibility map

Geotechnical studies relating to mining

Hydrogeological studies relating to land-use

Mining Engineering

Completed:

Asbestos Management Guidelines.

Guidelines for Environmental Damage Repair - auditing, bond release and related tendering procedures.

Radon Survey of Underground Mines.

Commenced and Continuing:

Survey of asbestos fibres in underground nickel operations.

Blast and environmental noise monitoring program in Kalgoorlie.

Procedures for repairs, modifications and inspections of classified machinery.

Tyre handling manual.

Guidelines for design of headframes and mining structures.

Mine winder inspections.

Design and operational standards for tailings dams.

Review of the existing guidelines relating to notice of intent preparation.

Statistical analysis of AXTAT and CONTAM data.

Guidelines for noise control in mines.

Royalties and Statistics

Financial modelling analysis of major resource projects was performed with particular attention given to iron ore, coal and petroleum royalties. Analysis also continued to assist in negotiation of revenue sharing arrangements between the State and Commonwealth governments for royalties recovered from offshore petroleum projects. A submission to the Commonwealth review of petroleum excise and royalty regimes was completed during the year as was a submission to the Industry Commission Inquiry on Minerals and Mineral Processing. A review of specific rate royalties commenced.

Petroleum

Completed

Reservoir engineering studies on fields including Saladin, Rosette, Griffin and Chinook.

Petrophysical appraisal of wells drilled particularly where hydrocarbons have been encountered.

Potential for recovery of associated gas from oil producing operations on the North West Shelf.

Commenced and Continuing

Amendments to the Petroleum and Pipelines Acts.

Surveys and Mapping

Completed

Geographic Informaton System (GIS) strategic plan implemented with the purchase and installation of a Unix workstation and ARC/INFO software package.

North Perth Basin Land Information System database. 90 computer plots generated for ongoing analysis and evaluation of resource and environmental information.

Data entry into the new WALIS Land Information Directory initiated.

Time Management Job Costing System designed to support divisional program management initiatives.

Graphical Digital Database: development of a database for EPA System 5, 7, 8 and 9 to facilitate ongoing analysis and evaluation of resources and environmental information.

Tenement Graphics: the digital capture of all live mining tenements in the South West Region of Western Australia.

Commenced and Continuing

MINEDEX: the location and plotting of all mineral resource and mining industry sites.

The use of geographical information systems is being examined in the Hamersley Range project study to provide a resource strategy for rational, long-term development of the Pilbara iron ore industry.

Computer assisted map production pilot study of geological mapping has advanced to a four colour electrostatic paper copy proof stage and requires only the production of plate-ready negatives to complete the assessment.

Global Positioning Systems: Field testing, post-processing and demonstrations for mining tenement boundary delineation and mapping control is ongoing to enable the development of specifications and guidelines for the use of the equipment.

The capture, examination, certification and integration of all surveyed mining tenement boundaries.

TENGRAPH: an electronic public plan replacement for the current analog system. It will show the position of mining tenements and other land information and allow for the receival of tenement applications and appraisals.

Appendix 4: Publications

The Department produces a wide range of publications designed to meet the diverse needs of all divisions.

These publications are, in the main, either informative or technical and serve all levels of the community — from basic information for the general public and school children to all levels of the mining and petroleum industry and Government.

On occasion the Department produces promotional literature to increase public awareness of the importance of the State's mining industry and the diverse role of the Department in its managment on the community's behalf.

Chemistry Centre (W.A.)

■ Technical

Agricultural Chemistry Laboratory

Distribution of Alkaloid Levels at Two Western Australian Lupin Receival Points D J Harris, Poster Paper, 6th International Lupin Conference, Chile, Pucon, November 1990.

An enzyme-linked Immunosorbent Assay (ELISA) for Lupin Alkaloids : Comparison with Gas Chromatography D G Allen, B N Greirson, D J Harris, Poster Paper, 6th International Lupin Conference, Chile, Pucon, November 1990.

Cadmium and Lead Content of Western Australian Commercial Lupin Seed D J Harris, B L Youngberg, D S Petterson (WADA), Poster Paper, 6th International Lupin Conference, Chile, Pucon, November 1990.

The Effect of Processing on the Mineral Content of Lupin Seed D J Harris, P Coates, D S Petterson (WADA)), Poster Paper, 6th International Lupin Conference, Chile, Pucon, November 1990.

Phosphate and Sulphate Adsorption Properties of Soils from the Coastal Plain of Southwest Western Australia D G Allen, R C Jeffery, R D'Ercole, Occasional Publication Agricultural Chemistry Laboratory, June 1991.

Chapter entitled Alkaloids in book Toxic Substances in Crop Plants D S Peterson (WADA), D J Harris, D G Allen (Royal Society of Chemistry, London) in press.

Reference Soils of South-Western Australia Australian Society of Soil Science (WA Branch) in press.

Environmental Chemistry Laboratory

Guidelines for the Metal Finishing Industry S Smith, G Ho, P Ryan, N Davies, P Hoar, R S Schulz, AWWA 14th Federal Convention, Perth, March 1991.

Investigation of Chemical Control of Peel Harvey Eutrophication A J Hendry and R D Taylor, Chemistry Centre Report, July 1990.

Trace Organic Analyses in Waters D J Ingraham to an Interdepartmental Workshop at the Water Authority of Western Australia, June 1991.

Analytical Aspects of PCB Analysis G F Ebell, RACI Environment Trave Organic Analysis Workshop, May 1991.

Analysis of Polynuclear Aromatic Hydrocarbons Using GC/MS Methodology R J Hart, RACI Environment Trave Organic Analysis Workshop, May 1991.

Forensic Science Laboratory

Detection of Petrol Residues in Human Viscera by Curie Wire Pyrolysis Gas Chromatography Mass Spectrometry - Select Ion Monitoring R C Hansson, 27th Meeting of the International Association of Forensic Toxicologists, Perth 1990.

The Effects of Petrol Sniffing on the Brain (Lead Encephalopathy) K A Margolius, R A Timms, C Kaelen and R C Hansson, 27th Meeting of The International Association of Forensic Toxicologists, Perth 1990.

Toxicology Screening P A Collins, R C Hansson and T Horsten, 27th Meeting of The International Association of Forensic Toxicologists, Perth 1990.

Detection and Identification of Acidic/Neutral Drugs T Horsten, 27th Meeting of The International Association of Forensic Toxicologists, Perth 1990.

Urinary Excretion of Cannabinoids C R Priddis and S G Kailis, 27th Meeting of The International Association of Forensic Toxicologists, Perth 1990.

Blood Alcohol Estimation Using Passive Breath Samples and Fuel Cell Based Breath Alcohol Analysers D Honey, Meeting of The International Association of Forensic Toxicologists, Perth 1990.

Cannabis and Driving Offences - Is There A Case for a Prescribed Level? N T Campbell, Conference of Police Personnel Engaged in Breath Analysis, Perth 1990.

Assessment of the Alcotch AR 1005 Breath Alcohol Analyse, D J Honey, Conference of Police Personnel Engaged in Breath Analysis, Perth 1990.

The Effect of Ventolin on Apparent Blood Alcohol Levels as Measured By The Drager Alcotest 7110 Breath Alcohol Analyser D Honey, Conference of Police Personnel Involved in Breath Testing, Perth 1990.

Evaluation of an Automated Gunshot Residue Detection System B Lynch and D Honey, Meeting of IAFS, Adelaide, October 1990.

Drugs and Driving - The Western Australian Experience 1985-90 N T Campbell, Meeting of IAFS, Adelaide, October 1990.

The Application of a Modified Carbon Wire Adsorption Solvent Extraction Technique to the Analysis of Accelerant and Volatile Organic Compounds in Arson Debris D Tranthim-Fryer, Meeting of IAFS, Adelaide, October 1990.

Latest Developments in the Use of Simultaneous Pyrolysis Methylation for the Identification of Crime Scene Evidence J Challinor, Meeting of IAFS, Adelaide 1990, October.

Structure Determination of Alkyd Resin by Simultaneous Pyrolysis Methylation J Challinor, Journal of Analytical and Applied Pyrolysis 18 (1991) 223.

A Simple Sulfur Electrode For Aqueous Sulfide Mineral Studies L Edwards, R Holiday and D Honey, Journal of Electron Analytical Chemistry 277 (1991) 425-433.

Identification and Analysis of Trimethylbiphenyl in Petroleum R Alexander, S H Ngo and R I Kagi, Journal of Chromatograph 538 (1991) 424-30.

A Fatal Case Involving Aldicarb S H Ngo, TIAFT Bulletin Volume 21(2) p 29-32.

A Fatal Case Involving Phenelzine and Amitriptyline R C Hansson, TIAFT Bulletin Volume 20 (3), p 14-17.

Gunshot Residue Detection B Lynch, Talk to Western Australian Society for Electron Microscopy, July 1990.

Explosive Residue Detection B Lynch, Talk to Bomb Scene Examiners Course, August 1990.

Health Chemistry Laboratory

Monosodium Glutamate in Western Australian Foods an Interdepartmental Report as part of the Western Australian Food Monitoring Program, August 1990.

The Determination of Thallium in Urine By Zeeman Graphite Furnace Atomic Absorption Spectrometry S M Jones and D N Collett, Atomic Spectroscopy (in print).

The Simultaneous Determination of Hippuric Acid And Creatinine In Urine By Liquid Chromatography M Hoare and F Ferrante, Chemistry In Australia (in print).

A Study Into The Use of Urinary Creatinine and Fluoride Levels as an Indicator of Community Exposure to Low Level Atmospheric Contaminants M B Rowe, Proceedings 9th Annual Conference of Australian Institute of Occupational Hygienists, Perth, 1990.

Kalgoorlie Metallurgical Laboratory

Pre-reduction of Manganese Ore for Ferromanganese Smelting V N Misra, Minerals, Materials and Industry, Proceedings of 14th Metallurgy, Edinburgh, Scotland, 2-6 July 1990, pp. 38-48.

Studies On The Flotation Of Mixed Oxide Sulphide Ores of Copper From Malanjkhand Deposit V N Misra et al, Mineral, Materials and Industry, Proceedings of 14th C.M.M.I., The Publication of I.M.M., Edinburgh, Scotland, 2-6 July 1990, pp. 367-374.

Studies On The Heap Leaching Characteristics of Western Australian Ores V N Misra, R E Browner and J H Kyle, Proceedings of World Gold '91, Aus. I.M.M. & S.M.E. Publications, Cairns, 21-25 April 1991, pp. 219-222.

Determination of Gold and Silver in Activated Carbon by AAS B C Das, Aus. I.M.M. Bulletin (in print).

Materials Science Laboratory

Glaze Faults In Ceramic Floor Tiles G M Ferguson, Austceram '90 International Symposium, Perth, February 1990.

Photodegradable Shopping Bags - Environmental Hazard or Blessing? G M Ferguson, IUPAC/RACI Polymer Division International Symposium, Melbourne, February 1991.

Biodegradation of Synthetic Polymers G M Ferguson, Chemistry in Australia 58(1), January 1991.

Photodegradable High Density Polyethylene - Based Shopping Bags - Environmental Hazard or Blessing? G M Ferguson, Polymer International, June 1991 (in Print).

Analysis of Waterlogged Leather using Fourier Transform Infrared Spectroscopy - A Preliminary Study G W Richardson and I Godfrey, Australian Institute for the Conservation of Cultural Materials, Tasmania, July 1990.

Black Prosthesis Revisited: A Study of Epinephrine - Induced Pigment Deposits on Poly (Methyl Methacrylate) T Chirila, R Cooper, I Constable, G Richardson, S Vijayasekoran, British Journal of Ophthalmology (in Print).

Mineral Processing Laboratory

Cyanide in Gold Mine Tailings - Interaction of Cyanide With Soils K Jones and W P Staunton, Proceedings Randol Gold Forum - Managing the Mine and Mineral Processing Environment, Cairns Qld, 16-19 April 1991.

Roasting and Cyanide Leaching of a Gold Bearing Pyritic Concentrate From Kalgoorlie J Avraamides, G Nguyen, J Dunn and J Graham, Proceedings World Gold '91 Joint Aus I.M.M. SME Conference, Cairns Qld, 21-23 April 1991, p45-53.

Prospects For The Direct Leaching of Gold Telluride-Recent Developments J Avraamides, I M Ritchie and S Jayasekera, Proceedings World Gold '91 Joint Aus I.M.M. SME Conference, Cairns Qld, 21-23 April 1991, p181-183.

Reduction of Vicinal Dihalides, II Leaving Group Effects On The Electrochemical Reduction of 1, 2-Dihalo-1, 2-Diphenylethanes and 1, 2-Dihalocyclohexanes J Avraamides, P Fawell and G Hefter, Australian Journal of Chemistry 44, 1991 p791-798.

Upsurge In Thermal Processing - Review Of Pyrosem WA, Seminar on Pyrometallurgical Operations J Avraamides, The Miner, June 1991, p16.

Characterisation of Cyanide Species in Mill Solutions K Jones, J McGuire and W P Staunton, Processing Aus I.M.M. Seminar CIP/CIL Plants - Problems and Answers, Kalgoorlie, 21 March 1991.

Pyrometallurgy Testing and the Chemistry Centre (WA) T O'Brien, Proceedings: Pyrosem WA - A Seminar On Pyrometallurgical Operations In Western Australia, Aus I.M.M., Murdoch University, Perth, 9 November 1990, p126-138.

Mineral Science Laboratory

Rare Earth Deposits In A Deceased Movie Projectionist. A New Case of Rare Earth Pneumoconiosis P M Waring, R J Watling, Medical Journal of Australia 153, 726, December 1990.

Thermospray Interface For High Performance Liquid Chromatography - Diffuse Reflectance Fourier Transform Infra-red Analysis R J Watling et al, Analytical Proceedings 28, 8, January 1991.

Stable Isotopes and Fluid Processes in Mineralisation H K Herbert and S E Ho, Geological Department University Extension, University Western Australia, Publ. 23, 382, 1990.

Sodium Bicarbonate-Rich Brines, Denison Trough: Potential Ore Fluids in Bowen Basin? H K Herbert and H R Krouse, Symposium: Geological Society Australia, 1990.

The Hydrogeology and Speleology of Yanchep L V Bastian, Proceedings of the Australian Speleological Federation, January 1991.

Sorting Out Old Yanchep Cave Discoveries L V Bastian, The Western Caves, Vol 30 1990.

Newly Indexed Caves and Entrances in Yanchep National Park L V Bastian, The Western Caver, Vol 30 1990.

Mineralogical Analysis of Concretes R M Clarke, (Proceedings) RACI Polymers and Building Technology Seminar, Perth, May 1990

The Significance of Asbestos Cement Building Products As A Source Of Airborne Asbestos R M Clarke, Australian Institute of Occupational Hygienists Conference, December 1990.

Advantages of State-Of-The-Art Computer Controlled SEM for Measuring Environmental Asbestos Concentrations R M Clarke and G Horsley, (Poster Presentation), Australian Institute of Occupational Hygienists, December 1990.

Advantages Of A State-Of-The-Art Computer Controlled SEM System For Measuring Environmental Asbestos Concentrations R M Clarke and G Horsley, 9th Annual Conference of Australian Institute of Occupational Hygienists, Perth, December 1990.

Racing Chemistry Laboratory

Detection Of Triamcinolone Acetonide in Equine Urine J M Ralston and A M Stenhouse, 27th Meeting of the International Association Of Forensic Toxicologists, Perth, October 1990.

Salicylic Acid Concentrations in Urine From Horses Raced in Western Australia A M Stenhouse, S Redhead and J M Ralston, 27th Meeting of the International Association Of Forensic Toxicologists, Perth, October 1990.

Detection of Heptaminol and Amphetamine type Drugs Using GC-MS in Negative Ion Chemical Ionisation C I Russo and S B Black, 27th Meeting of The International Association Of Forensic Toxicologists, Perth, October 1990.

The Use of Scintillation Proximity Assay (SPA) Reagent in Immunoassay G J Buck, S F Lucks and A M Stenhouse, 27th Meeting of the International Association Of Forensic Toxicologists, Perth, October 1990.

Explosives And Dangerous Goods

■ Informative

Notes for the Shotfirer

Summary of Accident Reports

Numerous guideline documents on many aspects of the Explosives,Flammable Liquids, Dangerous Goods (Road Transport) Regulations and Risks and Hazards.

"Explosay" - Quarterly divisional newsletter

Geological Survey

■ Informative - technical

Bulletins, Reports, Records, Memoirs - are geoscientific publications describing the geology, mineral resources, and groundwater occurrences of particular parts of the State.

Microfilm/fiche of released company reports on mineral and petroleum exploration are available for inspection or purchase.

■ Promotional

A wide range of Information Pamphlets covering diverse topics available.

■ Maps - technical

1:250 000 Geological series; 163 for whole State coverage
1:100 000 Geological series
1:250 000 Hydrogeological series
1:50 000 Urban geology/environmental series
1:2 500 000 State geological map
1:2 500 000 Mineral deposits map
1:2 500 000 State Hydrogeological map
1:2 500 000 Principal gold deposits map
1:2 500 000 Wells drilled for petroleum exploration map.

Mining Engineering

■ Informative

A Stake in the Future

Demography of long distance commuting in the Western Australian mining industry

Emergency preparedness and response guidelines - March 1991

Environmental management of quarries: development, operation and rehabilitation guidelines - March 1991

■ Geotechnical articles -

Close range photogrametric mapping of open pit mine wall failures 1990

Geotechnical studies for open pit mines - Western Australian operating

Guidelines for the environmental management of mining in arid areas

Guidelines for preparation of a Notice of Intent - vat leach or extensions to existing structures

Guidelines for the preparation of a" Notice of Intent (NOI)" and "Works Approval" application for new tailings dams or extensions to existing dams

Guidelines on safety bund walls around abandoned pits - 1990

List of operating mines in WA

List of gold producers

Making the Grade (video and booklets)

Minesafe

Mining Engineering Division Fatal and lost time injuries - 1989/1990

Notes on pit wall stability

Occupational injuries in Western Australian mines - 1990 calendar year

■ Safety law pamphlets (Series 1):

Accidents
Health and safety representative
Inspectors of mines and their powers
Record book
Resolutions of issues related to health safety and welfare

■ Safety law pamphlets (Series 2):

Workmen's Inspectors of Mines
Classified machinery
Mine ventilation officers
Mine safety law
Noise.

Seminar on open pit wall stability (produced in conjunction with the Chamber of Mines of Western Australia)

Significant incident reports - numbers 1 - 22

Stench gas emergency warning system - 1990

Ventilation Officers Course Notes (underground and surface) 1990

Safety Bulletins - numbers 1 - 5

Guidelines for the preparation of annual environmental reports 1991

■ Published Papers

Cannon, M P: Land use and land care awareness: a programme information exchange and education between pastoralist, mining industry and the public (1990)

Fisher, T: Ventilation underground diesel engines: the regulations and the facts (1990)

Hartley, B M; Hewson, G S: Contribution of regulatory programs to radiation risk reduction in the mineral sands industry. In: Proceedings of Minesafe International 1990. Perth: Chamber of Mines & Energy: 1990

Hewson, G S; Hartley, G S: Radiation research priorities in the mineral sands industry. Journal of Radiological Protection 10: 221-229; 1990.

Hewson G S; Ralph, M I: Determination of effective protection factors for half-mask respirators used at a mineral sands separation plant. Submitted for publication 1990.

Knee, M: Role of the Department of Mines in occupational health and safety in the mining industry (1991).

Lindbeck, K E: 1991, Quarry and Open Pit Rehabilitation, Paper presented to 8th State Conference of the Local Government Engineers Association of WA, 5-8 March 1991.

Torlach, J M: Atmospheric contaminants; exposure limits and practical applications 1990

Torlach, J M; Johnston, B: Tyre fires and explosions: causes and prevention

Whiteley, M F: Accident analysis as a management tool for improved safety performance 1990.

Mining Registration

■ Informative

Information Pamphlets

Basic Provisions
Guidelines on Reporting Requirements
Miner's Rights
Marking Out and Applying for Mining Tenements
Private Land Provisions
Transitional Provisions
Prospecting Exploration and Mining on Pastoral Leases
Mining Amendment Act No.22 of 1990
Exploration Licences - Graticular Boundary System
Prospecting Licences - A Guide to Holders

■ Promotional

Computerised Mining Tenement Index System.

Petroleum Division

■ Informative

Schedule of Onshore Petroleum Exploration and Production Requirements 1991.

List of Permittee/Licensee/Lessee Companies and titles.

Petroleum in Western Australia magazine.

Schedule of Specific Requirements as to Offshore Petroleum Exploration and production 1990.

Industry Safety memorandums.

Royalties & Statistics

■ Informative

Principal Gold Producers (produced twice a year for calendar and financial years).

Statistical Digest of Mineral Production (published twice a year to cover calendar and financial years).

Surveys And Mapping

■ Informative Maps

Mineral Tenement Maps

Department Public Plans

Index to Public Plans

Mining Act - Section 57(4) Areas

Graticular Section Plans

Petroleum Tenement Maps

Brochure of Petroleum Tenements

Petroleum Tenement Map of the State

Petroleum Act Graticular Section Maps

Petroleum Tenement Maps

■ Thematic Maps

Areas which have been held under Gold Mining Leases

Administrative Divisions

Historic Map - Wiluna to Kimberley Stock route

Index to Special Agreement Acts

Map Sheet Index

Mineral Production

Petroleum in Western Australia Tenement Map

Western Australian Localities Map with Gazetteer

Conservation Reserves of Western Australia, State Map

Conservation Reserves of Western Australia, South West Region

Aboriginal Reserves of Western Australia, State Map

Mine Plans - surface and underground

Appendix 5: Public Relations, Displays, Marketing

The year saw the Department's Communications Branch undertake a wide range of public relations and promotional activities.

These initiatives were all aimed at increasing public understanding and knowledge of the Department's role and operations, and also the important economic contribution made by the mining and petroleum industries in Western Australia.

Activities of the Branch during 1990-91 included:

Media Relations

Eighty-five media statements were prepared by the Branch and distributed to print and electronic media during the year.

These covered a wide subject range including the release of various industry statistics, amendments to the Mining Act, the release of new oil exploration areas, and comment upon major industry issues.

In addition, the branch responded to media requests for verbal comment on various issues and a sustained demand for very varied data by members of the general public. Again, these responses covered a wide subject range including health and safety, the environment, and policy issues.

Activities to increase the awareness of journalists included:

- A media tour of the Scuddles mine covering major mine safety and employee training initiatives;
- A familiarisation tour for journalists of the Department's Racing Chemistry Laboratory;
- A visit to the Perth office of Argyle Diamonds to be briefed on the work of the Government Diamond Valuer;
- The provision of historic photographs from the Department's archives to the Kalgoorlie Miner newspaper for use in a series of special articles on the early history of the Goldfields Region;
- The organisation and promotion of a special photographic competition featuring the State's mining and petroleum industries;
- The organisation of a special industry and media function for release of the Department's new guidelines for the safe abandonment of open pit minesites;
- A joint Police/Department of Mines media conference to release the findings of a "blitz" on vehicles transporting explosives and dangerous goods in the Perth metropolitan region;
- A media tour of the Kalgoorlie Explosives Reserve following publicity about site security;
- A media visit to the Kambalda nickel operations of Western Mining Corporation for a briefing on Department and company initiatives for minesite environmental rehabilitation; and a
- Media launch in Queen's Gardens, Perth, for the release of the Department's new guidelines for the rehabilitation of quarries.

Publications

The Department produced a wide range of technical and non-technical publications during the year.

A list of these technical publications appears in Appendix 4.

Publications produced to reach a more general audience included:

- A new profile booklet on the Department, explaining its role, objectives, history and current functions;
- A regular internal newsletter for staff;
- A new magazine called "Explosay" targeting the safe handling, storage and transport of dangerous goods;
- The Department's 180 page "Annual Review" - a full report on important events and trends within the mining and petroleum industry and evolutions within the Department itself;
- The annual "Statistical Digest" - a summary of key industry production volume and value figures, together with other supportive data on current operators, etc;
- Various reports and guideline books including the guidelines for both the safe abandonment of open

pit minesites and the rehabilitation of quarry sites; and

- A set of pamphlets promoting important aspects of minesite safety to workers in the industry.

Displays

The Department mounted a number of major public displays during the year, including:

- The "WAMEX" mining industry exposition, held annually at the Burswood Convention Centre, Perth;
- Minesite rehabilitation for the Library Association;
- The "Minesafe" exposition on mining safety held at the Burswood Convention Centre, Perth; and
- A display of the entries and winners in the Department's annual mining and petroleum industries photographic competition.

In addition, a number of displays were produced for a series of in-house expositions highlighting the role and function of specific divisions within the Department.

Other Public Relations Initiatives

Although the Department's Communications Branch undertakes the majority of public relations activities for the Department, other divisions also undertake a range of public relations activities, usually addressing specialist audiences.

During 1990-91:

The Geological Survey Division:

- Participated in and presented papers at the International Conference on Groundwater in Large Sedimentary Basins, and ran successful field excursions for the 3rd International Archaen Symposium held in Perth;
- Prepared a display for the joint Geological Society of Australia/Society of Exploration Geophysicists Conference in Sydney;
- In conjunction with the Petroleum Division organised a Western Australian Basins seminar at which a number of papers on the geology and petroleum potential of several sedimentary basins were presented by Department, BMR, and industry speakers. The Geological Survey also ran field excursions in the Bonaparte and Carnarvon basins for industry personnel; and
- Gave a seminar on open-pit stability at five centres in the Eastern Goldfields, Yilgarn and Murchison.

The Chemistry Centre:

- Organised and presented papers at the International Association of Forensic Toxicologists Conference held in Perth;
- Prepared a display for WAMEX featuring the mineral-related laboratories;
- Produced a range of brochures relating to general and specific aspects of the Chemistry Centre's laboratories;
- Arranged tours of the Chemistry Centre for various groups;
- Presented talks on many diverse topics throughout the year. These included: gold recovery, cyanide in the environment, treatment of swimming pools, pesticide analysis, heavy metal environmental problems, fire assaying, atomic absorption spectroscopy, liquid chromatography and atmospheric chemistry;
- Hosted a number of overseas and interstate visitors;
- Organised for two Research Fellows from Curtin University of Technology Pharmacy Department to spend their study leave in the Chemistry Centre, one in Agricultural Chemistry Laboratory and one in Forensic Science Laboratory;
- Helped work experience students, as well as University students, as part of their studies, participate in the activities of several Chemistry Centre laboratories; and
- Gave a series of lectures to third year chemistry students at the University of Western Australia. This involved a range of staff from several laboratories lecturing on various topics in applied analytical chemistry.

The Petroleum Division:

- Mounted a comprehensive display featuring the Division's role in the WA petroleum industry for the Petroleum Technology Australia 1990 Oil and Gas Expo at Burswood Superdome.

The Explosives and Dangerous Goods Division:

- Launched a quarterly newsletter titled "Explosay" specifically directed at the dangerous goods industry. Through the newsletter current information relating to explosives and dangerous goods, changing regulations and policy, accident details and details of the Division's operation is circulated to a broad industry base.

The Mining Registration Division:

- Held a Divisional exposition to increase awareness of its activities and expertise within the Department; and
- Arranged a Mining Registrars' conference and seminars for staff, industry and the public to explain major legislative amendments, including the implementation of a graticular boundary system for exploration licences.

Appendix 6: Boards and Committees

Statutory

Board of Examiners for Mine Managers and Underground Supervisors (Metalliferous)

Boards of Examiners, Mine Managers and Deputies (Coal)

Board of Examiners for Quarry Managers

Coal Mines Accident Relief Fund Committee

Coal Mines Accident Relief Fund Trust

Coal Miners Welfare Board

Mine Workers Relief Fund Board

Radiation Safety Board

Selection Committee for Inspectors of Mines

Mines Survey Board

Ventilation Board

Boards, Committees and Councils on which the Department has representation

Chemistry Centre (WA)

Academic Board - WA School of Mines

Advisory Committee - WA School of Mines

Advisory Committee for the Purity of Water

Agricultural Chemistry Laboratory Alterations Project Control Group

Amira Cyanide Project

Australasian Institute of Mining and Metallurgy – Kalgoorlie Branch

Australian Society of Soil Science (WA) Branch Committee

Australian X-Ray Analytical Committee

Bayswater Integrated Catchment Management Technical Advisory Committee

BrodieHall Mining Research and Consultancy Centre, WASM

Chemistry Centre CSA Works Committee

Chemistry Centre Chiefs of Laboratories

Chemistry Centre Computer Advisory Committee

Chemistry Centre Occupational Health and Safety Committee

Chemistry Centre Complex Bentley Construction and Fitout Project Control Group

Chemistry Centre Geological Survey Liaison Committee

Drug Advisory Committee

Fluoridation of Public Water Supplies Advisory Committee

Government Paint Committee – State Technical Working Group

Grain Pool Legume Advisory Committee

Hazardous Substances Advisory Committee

Hazardous Substances Advisory Committee

Working Party – Termiticides

Institute of Engineers (Australia) Kalgoorlie

International Lupin Executive

Kwinana Groundwater Pollution Control Technical Committee

Licence Advisory Panel of Rights in Water and Irrigation Act

Mines Department Hazardous Substances Committee

NATA Chemical Testing Registration Advisory Committee

Pesticides Advisory Committee

Poisons Advisory Committee

SAA CH/10/4 Mineral Standards Board Precious Metals Sub-committee

SAA MN/ Mineral Standards Board

SAA MN/1/1/7 Coal and Coke,Trace Elements

SAA MN/2/2 Chemical Analysis of Iron Ores

SAA MN/2/2/1 – X-Ray Fluorescence

SAA MN/3/2 Analysis of Aluminium Ores

SAA MN/4/2 Chemical Analysis of Heavy Mineral Sands Subcommittee

SAA MN/5/1 - Chemical Analysis of Copper, Lead, Zinc, Gold and Silver Ores and Concentrates

State Tender Board Cleaning Polishing and Maintenance Products

State Tender Board Cleaning Products Detergents

State Tender Board Paint Advisory Committee

Swan River Trust Environmental Quality Committee

Toxichem Chemical Information Project Professional Advisory Group

Veterinary Preparation and Animal Feed Advisory Committee

WA Food Advisory Committee

WAACHS Sub-committee on Asbestos Cement Products

WAACHS Subcommittee on Organochlorine Use as Termiticides

WARD Grants Assessment Panel (WA Research and Development)

Corporate Development Division

Archives Committee

Audit Committee

Common Use Purchasing System (CUPS)

Equal Employment Opportunity Consultative Committee

Government Accounting System Management Committee

Hedland College Council

Hedland College Finance and Staff Committee

Human Resource Planning Committee

Mines/BMA Monthly Review Committee

National RMS Users Group

Occupational Health and Safety Committee Mineral House Complex

RMS Management Committee for W.A.Government

RMS Users' Working Group

Reclassification Review Committee

Records Management Liaison Committee

Records Management Steering Committee

Staff Development Officers Network Coordinating Committee

Supplynet User Group – Government

Training and Development Committee

WA Government Task Force on Information Technology Establishments

Executive Division

Australasian Institute of Mining and Metallurgy

Australian Ionising Radiation Advisory Council

Australian Minerals and Energy Council – Ecologically Sustainable Development Working Group on Mining

Australian Minerals and Energy Council (AMEC)

Standing Committee of Officials

Carlisle Development Working Group

Chemistry Centre Accountability Steering Committee

Chemistry Centre Advisory Council

Chemistry Centre Steering Group

Corporate Executive Committee

Country Planning Council

Gold Producers' Association Ltd

Information Technology Advisory Committee

Land Information Plan Committee

Microfilm Steering Committee

Mines Department Computer Co-ordinating Committee

Mines Department Finance Committee

Mining Act Steering Committee

Mining Industry Liaison Committee

Mining Tenement Information System (MTIS) Steering Committee

Publications Review Committee

Standing Committee to Ministerial Council on Mining and Conservation

WA Advisory Committee on Hazardous Substances

WA Mining Education Consultative Committee

WA Water Resources Council

WA Water Resources Council Conservation Committee

Explosives Division

Association of Australian Port and Marine Authorities Dangerous Goods Committee

Explosives Dangerous Goods Systems Committee

Explosives Division Operations Planning Committee

Explosives Division Personal Computer Project Planning Committee

Hazardous Industries Technical Group

Kemerton Industrial Working Committee

Kemerton Park Advisory Board

Kwinana Industrial Coordinating Committee Improvement Plan 14 Working Group

Kwinana Integrated Emergency Management System Executive Coordinating Committee

Kwinana Integrated Emergency Management System Emergency Services Subcommittee

Kwinana Integrated Emergency Management System Technical Advisory Subcommittee

National Task Force on Hazardous Industry and Landuse Safety Planning

Public Safety Sub-committee

SAA CH/9 Safe Handling of Chemicals

SAA ME/15 Liquefiable Petroleum Gases

SAA ME/17 Flammable and Combustible Liquids

SAA ME/50 Road/Rail Tankers Fluid Transfer Components

SAA ME/57 Road Tankers for Hazardous Liquids and Gases

SAA ME/70 Liquefied Natural Gas Storage and Handling

State Government Counter Disaster Advisory Committee

Transport of Dangerous Goods Competent Authorities Subcommittee

Transport of Dangerous Goods Drafting Subcommittee

Transport of Dangerous Goods Explosives Working Group

Transport of Dangerous Goods Advisory Committee

WA Hazardous Materials Emergency Management Scheme Preparedness and Response Subcommittee

Working Party for Transport Routes (WAACHS)

Geological Survey Division

Australian Earth Science Information System (AESIS) Advisory Committee

Australian Mineral Foundation (AMF) Council

Australian Resources Industry Database (ARID) Advisory Council

Bauxite Sub-committee

Bunbury/Wellington Regional Planning Committee

Chamber of Mines and Energy Liaison Group

Coastal Groundwater Scheme Steering Group

Coastal Management Coordinating Committee

Cockburn Cement Dredging and Management Program Working Group

Cockburn Groundwater Pollution Control Advisory Committee

CSIRO Mindarie Waste Disposal Site Committee

Environmental Liaison Committee

EPA Red Book Task Force

Extractive Industry Committee

Geological Map Revision Group

Geological Survey Computer Policy Committee

Geological Survey Liaison Committee

Geological Survey Library Advisory Committee

Geology Advisory Committee

Gnangara Mound Technical Advisory Group

Government Geologists' Conference

Government Geosciences Database Policy Advisory Committee

GSWA State Water Resources Information Steering Committee

GSWA/WAWA Groundwater Liaison Committee

Harding Dam Water Quality Committee

Hydrogeology Subcommittee (of the Geological Survey Liaison Committee)

Integrated Catchment Management Policy Group

Kingstown Advisory Committee

Land Salinisation Sub-committee of RSC

Petroleum Coordinating Committee

RSC Landuse and Groundwater Interactions on the Coastal Plain Sub-committee

RSC Water Resource Catchment Rehabilitation

Research on Land Use and Water Supply Steering Committee

Rockmin Review Committee

Rockmin Steering Committee

Rottnest Island Authority Environmental Advisory Committee

Rottnest Island Research Committee

Southwest Seismic Zone Data Base Program Liaison Committee

State Tender Board Procurement of Motor Vehicles Advisory Sub-committee

Technical Committee for Estimating Recharge for Sub-regions with Multiple Landuse

WA Water Resources Council Groundwater Management Committee

WAMEX Review Committee

WAMEX Steering Committee

WAMEX Working Group

WAPEX Steering Committee

WAPEX Working Group

WAWA/SWRIS Review Committee

WAWA/SWRIS Steering Committee

Yilgarn Craton Liaison Subcommittee of the Geological Survey Liaison Committee

Mining Engineering Division

AXTAT

Board of Examiners (Coal Mines Regulation Act)

Board of Examiners (Mine Managers and Underground Supervisors) – Mines Regulation Act

Board of Examiners (Quarry Managers)

Coal Education Committee of Collie – TAFE

Coal Miners Welfare Board

Coal Mines Accident Relief Fund Trust

Collie Federated School of Mines Advisory Council

Mines Radiation Safety Board

Mines Rescue Competition Committee

Mines Rescue Trainee Assessment Committee

Mines Survey Board

Mines Ventilation Board

Mining Contaminants Monitoring System (CONTAM) Steering Committee

Mining Operations Group

WA Coal Industry Council

WA Coal Industry Council Standing Committee

WACIC - Occupational Health and Safety Control Committee

Petroleum Division

Committee for Local Industry Participation

Consultative Committee on Safety in the Offshore Petroleum Industry in Australia

Government Regulating Authorities Pipelines Advisory Group

Montebello Island Marine Park Proposal Ad Hoc Committee

North West Shelf Security Working Group

Offshore Engineering Program Advisory Panel

Onshore Petroleum Legislation Sub-committee

Petroleum Conservation Consultative Committee

Petroleum/Fishing Industries Appeal Meetings

Petroleum Industry Liaison Committee

Standing Committee on Offshore Petroleum Legislation

State Committee for Combating Marine Oil Pollution

Mining Registration Division

Exemption Sub-committee

Mining Registration Divisional Committee

Mining Registration Unit Managers' Committee

Tenement Rentals and Expenditure Systems (TRAXS)

Royalties and Policy Development Division

Minedex Steering Committee

Surveys and Mapping Division

Australian Institute of Cartographers (WA Division)

CSA Cartographic Sub-association

Computeraided Map Publishing Committee

Geodetic Survey and Computing Technical Sub-committee

Geographic Names Committee

GIS/LIS Steering Committee

Multiskilling and Job Design Consultative Committee

Surveys and Mapping Divisional Assessment Panel

WA State Emergency Service Liaison Officers

WA Survey and Mapping Advisory Committee

WALIS Council

WALIS Digital Capture of Cadastral Information Sub-committee

WALIS Technical Sub-committee

WAPMAP Steering Committee

Appendix 7: Departmental Directory

HEAD OFFICE

Department of Mines
Mineral House Complex
100 Plain Street (cnr Adelaide Terrace)
EAST PERTH Western Australia 6004
Telephone (09) 222 3333
Fax (09) 222 3430
Telex AA95791 MINEWA

Office of Director General of Mines
8th Floor Mineral House South
100 Plain Street (cnr Adelaide Terrace)
EAST PERTH Western Australia 6004
Telephone (09) 222 3333
Fax (09) 222 3510
Telex AA95791 MINEWA

DIVISIONS

Chemistry Centre WA

Chemistry Centre WA
125 Hay Street
EAST PERTH Western Australia 6004
Telephone (09) 325 5544
Fax (09) 325 7767
Telex AA95791 MINEWA

Mineral Processing Laboratory
19 Catherine Street
BENTLEY Western Australia 6102
Telephone (09) 458 9088
Fax (09) 351 8197
Telex AA95791 MINEWA

Regional Office

Kalgoorlie Metallurgical Laboratory
95 Egan Street (Box 881)
KALGOORLIE Western Australia 6430
Telephone (090) 220 120
Fax (090) 912 762

Corporate Development

Corporate Development Division
7th Floor Mineral House South
100 Plain Street (cnr Adelaide Terrace)
EAST PERTH Western Australia 6004
Telephone (09) 222 3333
Fax (09) 222 3430
Telex AA95791 MINEWA

Explosives and Dangerous Goods

Explosives and Dangerous Goods Division
9th Floor Mineral House North
100 Plain Street (cnr Adelaide Terrace)
EAST PERTH Western Australia 6004
Telephone (09) 222 3333
Fax (09) 222 3525
Telex AA95791 MINEWA

Baldivis Explosives Reserve
Stakehill Road
BALDIVIS Western Australia 6171
Telephone (09) 524 1301
Fax (09) 524 1792

Regional Office

Kalgoorlie Explosives Reserve
Piccadilly Street West
KALGOORLIE Western Australia 6430
Telephone (090) 218 246
Fax (090) 913 222

Geological Survey of WA

Geological Survey of Western Australia
5th Floor Mineral House South
100 Plain Street (cnr Adelaide Terrace)
EAST PERTH Western Australia 6004
Telephone (09) 222 3333
Fax (09) 222 3633
Telex AA95791 MINEWA

Geological Survey Transport and Equipment Store
37 Harris Street
CARLISLE Western Australia 6101
Telephone (09) 470 0308

Geological Survey Core Library
15 Harold Street
DIANELLA Western Australia 6062
Telephone (09) 222 3277

Geological Survey Laboratories
40 Cohn Street
CARLISLE Western Australia 6101
Telephone (09) 470 0324

Regional Office

Kalgoorlie Regional Office
WA School of Mines
Egan Street
KALGOORLIE Western Australia 6430
Telephone (090) 213 066
Fax (090) 912 428

Mining Engineering

Mining Engineering Division
6th Floor Mineral House North
100 Plain Street (cnr Adelaide Terrace)
EAST PERTH Western Australia 6004
Telephone (09) 222 3333
Fax (09) 325 2280
Telex AA95791 MINEWA

Exploration Safety and Drilling
91 Briggs Street
WELSHPOOL Western Australia 6106
Telephone (09) 470 0300
Fax (09) 362 5694

Regional Offices

Collie

Coal Industries Council
Unit 1 Forrest Forum
Forrest Street
COLLIE Western Australia 6225
Telephone (097) 344 599
Fax (097) 344 142

Regional Mining Engineer
66 Wittenoom Street
Collie Western Australia 6225
Telephone (097) 341 222
Fax (097) 341 606

Kalgoorlie

Regional Mining Engineer
Brookman Street (Box 671)
KALGOORLIE Western Australia 6430
Telephone (090) 213 066
Fax (090) 213 612

Karratha

Regional Mining Engineer
Hedland Place (Box 518)
KARRATHA Western Australia 6714
Telephone (091) 868 243
Fax (091) 868 241

Mining Registration

Mining Registration Division
1st Floor Mineral House North
100 Plain Street (cnr Adelaide Terrace)
EAST PERTH Western Australia 6004
Telephone (09) 222 3333
Fax (09) 222 3452
(09) 222 3444
Telex AA95791 MINEWA

Regional Offices

Broome

Mining Registrar
Court House (Box 28)
BROOME Western Australia 6725
Telephone (091) 921 137
Fax (091) 921 878

Carnarvon

Mining Registrar
Court House (Box 35)
CARNARVON Western Australia 6701
Telephone (099) 411 082
Fax (099) 412 779

Coolgardie

Mining Registrar
40 Bayley Street (Box 41)
COOLGARDIE Western Australia 6429
Telephone (090) 266 066
Fax (090) 266 204

Kalgoorlie

Mining Registrar
Brookman Street (Box 364)
KALGOORLIE Western Australia 6430
Telephone (090) 213 066
Fax (090) 912 428

Kununurra

Mining Registrar
Court House (Box 917)
KUNUNURRA Western Australia 6743
Telephone (091) 681 011
Fax (091) 681 103

Leonora

Mining Registrar
Rochester Street (Box 4)
LEONORA Western Australia 6438
Telephone (090) 376 106
Fax (090) 376 248

Marble Bar

Mining Registrar
Bohemia Road (Box 7)
MARBLE BAR Western Australia 6760
Telephone (091) 761 044
Fax (091) 761 048

Meekatharra

Mining Registrar
Main Street (Box 7)
MEEKATHARRA Western Australia 6642
Telephone (099) 811 008
Fax (099) 811 482

Mt Magnet

Mining Registrar
Richardson Street (Box 13)
MT MAGNET Western Australia 6638
Telephone (099) 634 040
Fax (099) 634 488

Norseman

Mining Registrar
Princep Street
NORSEMAN Western Australia 6443
Telephone (090) 391 082
Fax (090) 391 657

Southern Cross

Mining Registrar
Great Eastern Highway
SOUTHERN CROSS Western Australia 6426
Telephone (090) 491 107
Fax (090) 491 431

Petroleum Division

Petroleum Division
3rd Floor Mineral House South
100 Plain Street (cnr Adelaide Terrace)
EAST PERTH Western Australia 6004
Telephone (09) 222 3333
Fax (09) 222 3515
Telex AA95791 MINEWA

Royalties and Policy Development Division

Royalties and Policy Development Division
10th Floor Mineral House North
100 Plain Street (cnr Adelaide Terrace)
EAST PERTH Western Australia 6004
Telephone (09) 222 3333
Fax (09) 222 3289
(09) 222 3069
Telex AA95791 MINEWA

Surveys and Mapping Division

Surveys and Mapping Division
2nd Floor Mineral House North
100 Plain Street (cnr Adelaide Terrace)
EAST PERTH Western Australia 6004
Telephone (09) 222 3333
Fax (09) 222 3342
Telex AA95791 MINEWA








ANNUAL REVIEW
1990-91

DEPARTMENT OF MINES
Western Australia

Department of Mines
Western Australia
Mineral House
100 Plain Street
EAST PERTH 6004
Telephone: (09) 222 3333
Fax: (09) 222 3430

Cover photographs: Silhouette of the monopod structure above the Yammaderry oilfield, offshore from Onslow.

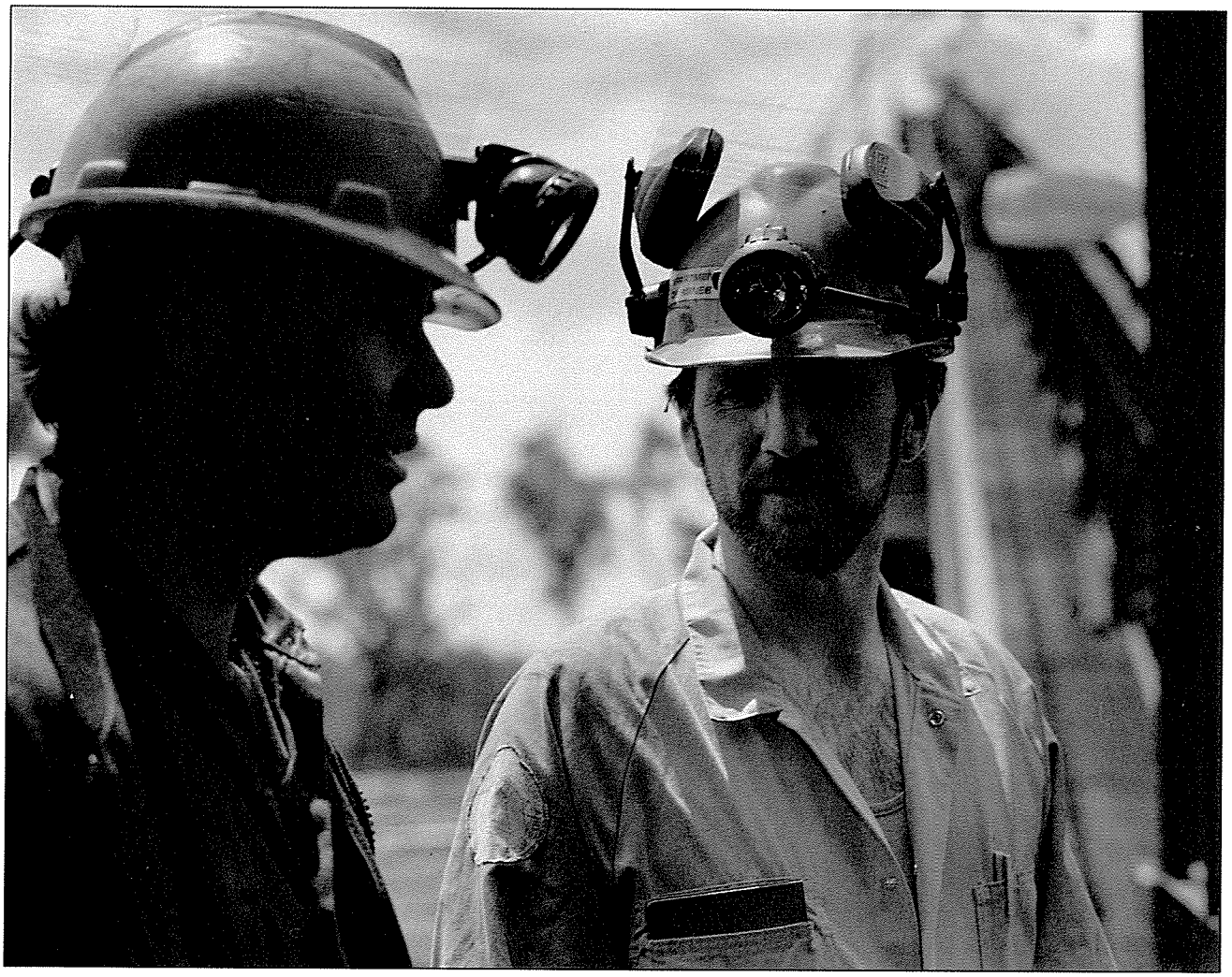
Loading operations at BHP Iron Ore's Mt Whaleback mine at Newman.

Photograph this page: The Southern Cross drilling rig pictured in waters near Rottnest Island.

ANNUAL REVIEW

W E L C O M E

Welcome to the Department of Mines' 1990-91 Annual Review.
The review covers the Department's activities and objectives for the year. It also provides a comprehensive outline of industry and community activities which are relevant to the Department's operation.



The Department employs more than 30 inspectors in various capacities throughout the State, including David Cameron, the District Inspector of Coal Mines at Collie. He is pictured (above right) discussing safe work practices with a company electrician at the entrance of the Western Collieries No. 7 deep mine.

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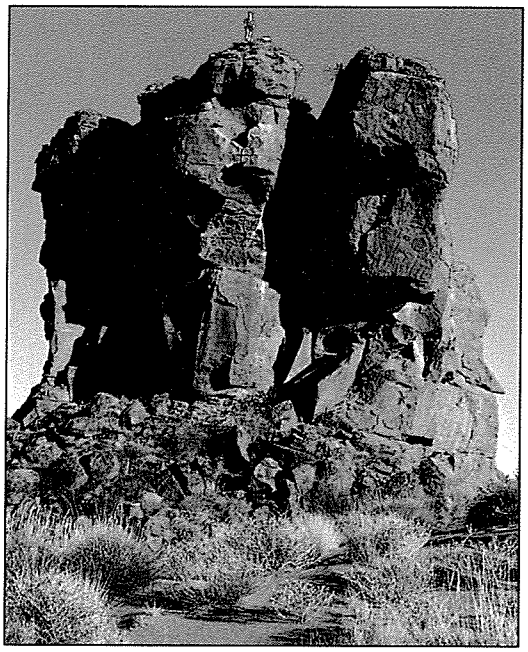
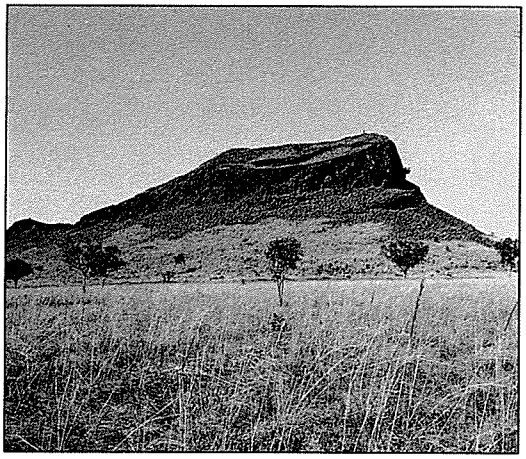
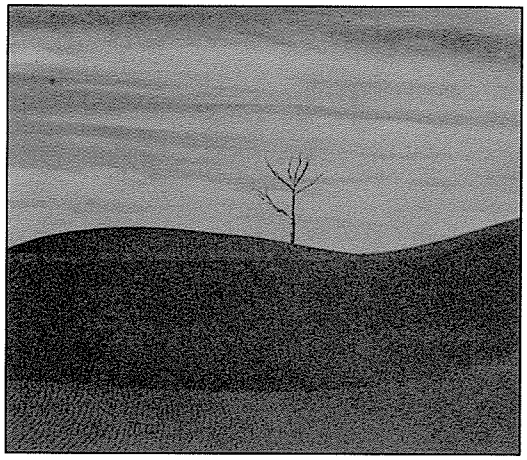
ANNUAL REVIEW

C O N T E N T S







Past geological environments present a fascinating series of landscapes for modern-day geologists and others, as shown by the following examples: Hanging Rock (top), formed about 640 million years ago, rises boldly out of the Little Sandy Desert in outback WA. Mt North (middle photo), the weathered core of a lamporite volcanic pipe in the Ellendale diamond field, was formed after erupting from the bowels of the Earth about 20 million years ago. The bottom photo shows sand dunes formed in the heart of the Great Sandy Desert during the last few years — and are still moving.

MINISTER FOR MINES

FOREWORD

My congratulations go to the mining and petroleum industries of Western Australia for yet another outstanding performance in 1990-91.

Amid pressures of economic uncertainty there has never been a year when these industries have contributed more to the wellbeing of the State.

Figures contained within this Annual Review provide some basic, but compelling facts about the worth of the mining and petroleum industries to Western Australia.

The past year saw:

- the value of production rise by 18% to $12.3 billion;
- the investment of approximately $560 million in mineral and petroleum exploration;
- the value of exports increase to more than 70% of Western Australia's foreign earnings; and
- record employment of 36 830 people in the mining and petroleum industries.

It is expected that the resources sector will continue to play a vigorous and important role in leading Western Australia and the rest of the nation out of recession.

Resource projects worth an estimated $5.8 billion are either underway or on the drawing board at present. They will generate an estimated 4 500 jobs during construction and about 1 300 full time jobs when they become fully operational.

Petroleum will lead the way, with Woodside Petroleum Ltd spending $2.8 billion on construction of the Goodwyn A platform and additional liquefied natural gas (LNG) processing and shipping facilities as part of its Phase Three expansion.

Major proposed mineral developments include the Marandoo iron ore project worth $500 million and the Yakabindie nickel project which will cost an estimated $350 million.

Company directors and investors behind these and several smaller, but nevertheless important developments, are to be applauded for their continuing confidence in the resources sector.

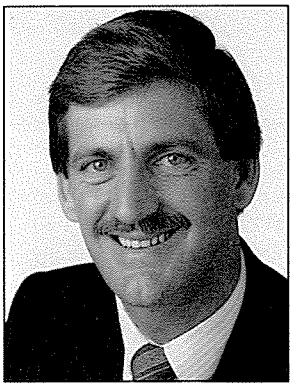
Their investment in the State's biggest industry comes at a time when there is debate over access to land for mineral exploration, increasing demands to protect the environment and increasing interest in occupational health and safety issues.

In all these sensitive and demanding areas, the Department of Mines has a front-line role in meeting the needs and protecting the interests of all Western Australians.

While it has been another record year for the resources sector, it is also appropriate that mention be made of the excellent safety performance of the mining industry during 1990-91.

Despite employing a record number of people, the number of workdays lost through injury in the mining industry fell by more than 13%. This is a commendable result.

I trust you will find the following pages of this publication of interest and practical use, and wish you a rewarding and successful year ahead.



Gordon Hill, JP, MLA
Minister for Mines

DIRECTOR GENERAL OF MINES

THE YEAR IN REVIEW

In a difficult year for all sectors of the Western Australian economy, the mining and petroleum industry again underwrote the employment opportunities and standard of living of all Western Australians.

The industry has become the backbone of the State economy, and this will continue for the forseeable future. The mining and petroleum sectors are vital to us all as they alone can provide the export income needed to repay Australia's foreign debt.

The importance of the industry is underlined by the fact that, in a year when most sectors experienced decline, the total value of production rose to $12.3 billion — an increase of 18% over 1989-90 — which was an impressive result.

Mineral and petroleum output was at record levels with more than 80% of production exported to provide around 70% of WA's export earnings. If this trend continues Western Australia will provide about 40% of the nation's total mineral and energy exports in 1991-92.

The expansion and the changing nature of operations in the mining and petroleum industry impacted on the Department of Mines. Increasing community expectations in the vital areas of conservation and safety have added to the workload of the Department. The industry too, has placed increasing demands on the Department for a level of service and operational efficiency to match its own growth and technological advances.

All nine divisions of the Department have been affected. At a time when the public sector has been under pressure to reduce numbers, raise productivity and increase cost efficiency, I am pleased to say the Department has met the challenges with a positive, dedicated, across-the-board effort from all divisions.

The Department's commitment to Corporate Planning continued with the introduction of Program Management, resulting in the comprehensive integration of corporate planning and the budgeting process. Specific actions to address key issues confronting the Department were identified and goals set, with special emphasis on the environment and the safety of mineral and petroleum industry workers. An operational plan is currently being developed to ensure optimum utilisation of all available resources in meeting industry and public demands. This Annual Review provides a comparison of planned achievements and outcomes based on the plans to enable the reader to judge how effectively we met our goals.

A major focus of the Department's activities remains the safety of all mining and petroleum operations for workers and the public. Despite a heartening downward trend in the long-term rate of incidents, the Department remains very concerned with the number of fatalities in the mining sector. During the year an inquiry, chaired by the Director of the Mining Engineering Division, was completed on safe working practices in underground gold mines. The recommendations contained in the report are now being implemented. The Department is hopeful that co-operation between industry organisations, the unions and companies will see a reduction in the number of fatalities along with the overall long-term reduction in lost time injuries.

The Government has established a broader enquiry into the health and safety legislation governing the mining industry and the administration of that legislation. The enquiry is being conducted by Mr E R Kelly, former Chief Commissioner of the Western Australian Industrial Relations Commission. The Department is co-operating fully with Mr Kelly and has produced a detailed submission for his consideration.

The problems of open pit wall stability were exhaustively addressed by the Geological Survey Division with the production of

guidelines and an extensive industry education program.

The status of radiation safety in the mineral sands industry was closely examined in the Technical Audit Team report of September 1990. The team found that regulatory surveillance by the Department had been very effective and initiatives in radiation safety introduced by the Department had been highly successful.

Increased emphasis on the environment and land rehabilitation generated a higher workload for the Department, especially for the Mining Engineering and Petroleum Divisions. A number of positive initiatives were taken and some excellent results produced. Five new environmental officers, four in the Department's Mining Engineering Division and one in the Petroleum Division, were appointed.

Through the work of the Environmental Officers, a range of guidelines and reports were produced. These included guidelines for the environmental management of quarries, and the design and rehabilitation of tailings dams and waste dumps. Additionally, schedules of specific requirements for onshore and offshore petroleum exploration and production, with environmental impact assessment checklists, were produced.

In other environmental initiatives the Geological Survey Division made a significant contribution to the Government's new policy on exploration and mining in conservation areas, while the Chemistry Centre continued its comprehensive cyanide monitoring programs. Explosives and Dangerous Goods Division staff also ensured that the transport and storage of dangerous goods met all Environmental Protection Authority requirements and chaired a working group to develop criteria for setting routes for the road transport of dangerous goods.

Access to land for exploration and mining remained a key issue for the mining and petroleum sectors during the year. Following extensive consultation the Government announced a new policy on access to areas of conservation value. Under this policy, known as Resolution of Conflict, exploration and mining will in the future be banned in National Parks. For Conservation Reserves, working arrangements have been developed for assessment of conservation and environmental issues. Assessment will be undertaken by the Mines Department in consultation with the Departments of Conservation and Land Management, and the Environmental Protection Authority. These processes should expedite consideration of mining tenement applications.

The industry experienced significant problems during the year with access to Aboriginal Reserves and site clearances. Major resource projects were delayed and to overcome this impasse a Development Policy Ministerial Council was established. It is expected that it will produce a set of guidelines for use by industry, Government departments and local Aboriginal communities.

In October-November, the Department's Explosives and Dangerous Goods Division, in conjunction with the Police, conducted a blitz on vehicles transporting dangerous goods, thereby raising awareness among operators of their responsibilities in safeguarding the public from any hazards. The Division also spent considerable time assessing some of the State's ports for hazards associated with the import and storage of ammonium nitrate. The process of drafting the new Dangerous Goods Regulations continued.

Initiatives by the Department to facilitate the exploration and development of natural resources and to provide a more efficient and effective service to the industry included the further development of computer-based programs and the streamlining and updating of

operations, especially in the Surveys and Mapping and Mining Registration Divisions.

Ultimately,a suite of computer database programs including WAMEX, WAPEX, MINEDEX, ROCKMIN, TENDEX and TENGRAPH, will provide significant benefits to industry by releasing data vital to exploration programs and providing details in both data and graphic form of the status of mining tenements across the State. Work also continued on a Geographic Information System that will assist the resolution of complex environmental, planning and Aboriginal issues and assist industry in speeding up the planning process.

A significant stimulus to the mineral exploration industry came in September 1990 with the release of the landmark publication Memoir 3. This definitive reference on the geology of the State is the culmination of 15-years research and mapping by over 50 geoscientists in the Geological Survey Division.

The Surveys and Mapping Division, pursuant to the Department's overall information technology plan, introduced state-of-the-art technology. Computer-aided drafting and mapping will revolutionise the production of map products and the way the Division's functions are structured, while the introduction of Global Positioning Systems will alter the face of surveying and ultimately lead to considerable cost saving. When fully operational the Landcap/Landraw system will result in major changes to traditional mapping by electronically generating plans and diagrams.

As part of an overall strategy to simplify operations the Department introduced graticular sections, dividing the State into 1.4 million regular blocks, one minute by one minute in size.

Consequently, mining exploration tenement applicants have certainty about the area they have been given to explore and the Mining Registration Division is able to supply a superior service to explorers. In a similar vein the Petroleum Division announced the creation of a new type of petroleum exploration lease, a Drilling Reservation, that allows exploratory drilling with a limited tenure of 12 months without the onerous requirement of a 5-year financial commitment. These Reservations will complement the new system of basin-wide releases by allowing petroleum explorers to tailor their exploration to their financial capacity and priorities, and the geology of an area.

The Chemistry Centre continues to provide a wide range of analytical and investigative support to soil and plant testing, forensic science, environmental health assessments, the detection of drugs in racing and to mineral science and mineral processing projects. Acquisition of new equipment, including an X-ray diffractometer and an inductively-coupled plasma mass spectrometer, allowed the Centre to increase the diversity of the analytical and advisory services it gives to industry, Government and the public.

The total revenue collected by the Department or verified on behalf of the Commonwealth Government was $414.1 million. Of this $380.5 million passed through the State Consolidated Revenue Fund (CRF). The CRF revenue collection was 19% higher than in the previous year and included $49.7 million lease fees and rentals and $6.4 million in charges and sales.

Royalties staff examined 500 royalty returns, prepared audit manuals for the entire North West Shelf project and Barrow Island and negotiated with a number of mineral and petroleum producers to finalise issues involving significant royalty amounts.

On the expenditure side, payments made by the Department from Consolidated Revenue amounted to $44.15 million, a fall over the previous financial year of some $700 000.This

DIRECTOR GENERAL OF MINES

THE YEAR IN REVIEW

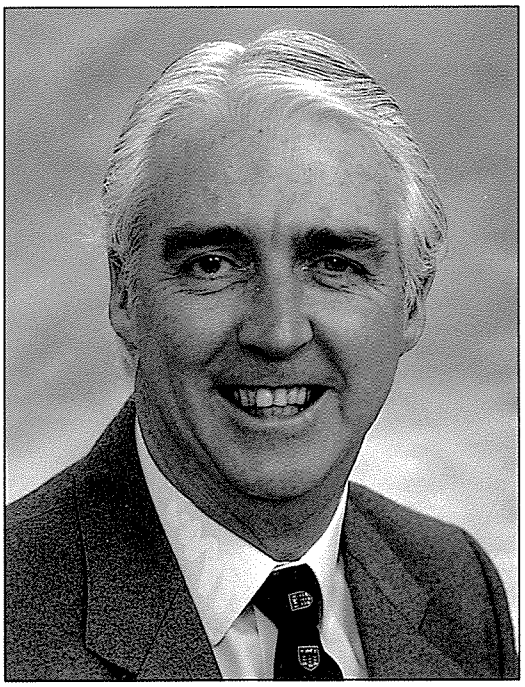
outstanding result reflects well on the expertise and dedication of all officers in the Department.

The drafting and amendment of legislation continued apace as the Department fulfilled its regulatory role and responded to industry and Government directives. Major changes in petroleum legislation were gazetted to be proclaimed later in the year as were changes to the Mining Act and Explosives and Dangerous Goods Act. Current mining legislation is working extremely well and many problems of past years have been eliminated.

During the year the Department experienced a reduction in staffing levels due to restraints on recruitment and the closure of the Drilling Branch. This brought to a close an activity of the Department which began in the 1950s, when the need for information on groundwater reserves in the Collie coalfields saw the creation of the Branch. In subsequent years the Drilling Branch was successfully involved in a variety of programs to define and monitor groundwater reserves across the State. Through its efforts many rural communities today have adequate supplies of potable water.

The staff turnover rate fell 13% with 137 staff resigning or retiring compared with 157 in the previous year. Restrictions on the filling of vacancies however resulted in only 107 new staff being appointed. In 1990-91 the Department employed the equivalent of 765 full time staff compared to 795 in 1989-90. Management and monitoring strategies developed as part of the Corporate Planning process proved their worth and the Department was able to optimise the use of its limited resources and undertake most programs without any serious reduction in the level of services provided. This was only made possible by a sustained effort from all divisions.

With reductions in Government funding and staffing levels, increasing demands from the mining sector and the need for an expanded effort in our safety and environmental programs, the Department faces a testing year ahead. I am certain our commitment to excellence and the dedication and professionalism of all officers will carry us through. The industry, public and Government can rest assured that the Department will strive to maintain service standards despite the financial and staffing reductions.



D R Kelly
Director General of Mines

THE DEPARTMENT

RESPONSIBILITIES AND OBJECTIVES

BACKGROUND

The Department of Mines was established in the wake of massive interest in mining generated by the discovery of gold at Coolgardie in 1892 and Kalgoorlie in June 1893.

The Department was officially established on 1 January 1894 when the mining registration and survey functions of the Lands Department were combined with the Geological Survey of Western Australia.

The new regulatory body set out to ensure the safe and orderly development of mineral resources in Western Australia, and allow the Government and community to benefit from these activities.

These responsibilities have remained an integral part of the Department for the last 97 years.

However, the role of the Department has been expanded over the years to include the Chemistry Centre (WA), plus functions relating to the assessment of petroleum exploration and development, underground water resources and the handling of explosives and dangerous goods.

To carry out these responsibilities the Department employs approximately 765 people and operates on a budget in excess of $44 million.

Its workforce includes geoscientists, mining and petroleum engineers, cartographers, chemists, metallurgists, economists and others who ensure that the duties of the Department are carried out in an efficient and professional manner.

Royalties and rents collected by the Department from mineral and petroleum activity in W.A. during 1990-91 yielded $414 million.

The Department administers 17 Acts of Parliament, the principal ones being the Mining Act, the Mines Regulations Act and the Petroleum Act.

Through the authority of these Acts, the Department oversees an industry which directly employed more than 36 000 people and achieved production valued at $12 269 million during the 1990-91 financial year.

VISION

The Department of Mines will be recognised for its commitment to excellence and quality in meeting the needs of the community, industry and Government in the areas of minerals and science.

CORPORATE PHILOSOPHY

Western Australia is fortunate in being endowed with abundant mineral and petroleum resources, held in trust by the Government on behalf of the community.

Recognising that the community requires mineral and petroleum products to sustain its standard of living, the Department of Mines has been given the responsiblity to ensure that the exploration for and development of these resources is carried out equitably, with due care for the environment and worker safety, and in the best interests of the commmunity.

The general principles and philosophies fundamental to the Department's role, programs, structure, functions and strategy are summarised hereafter:

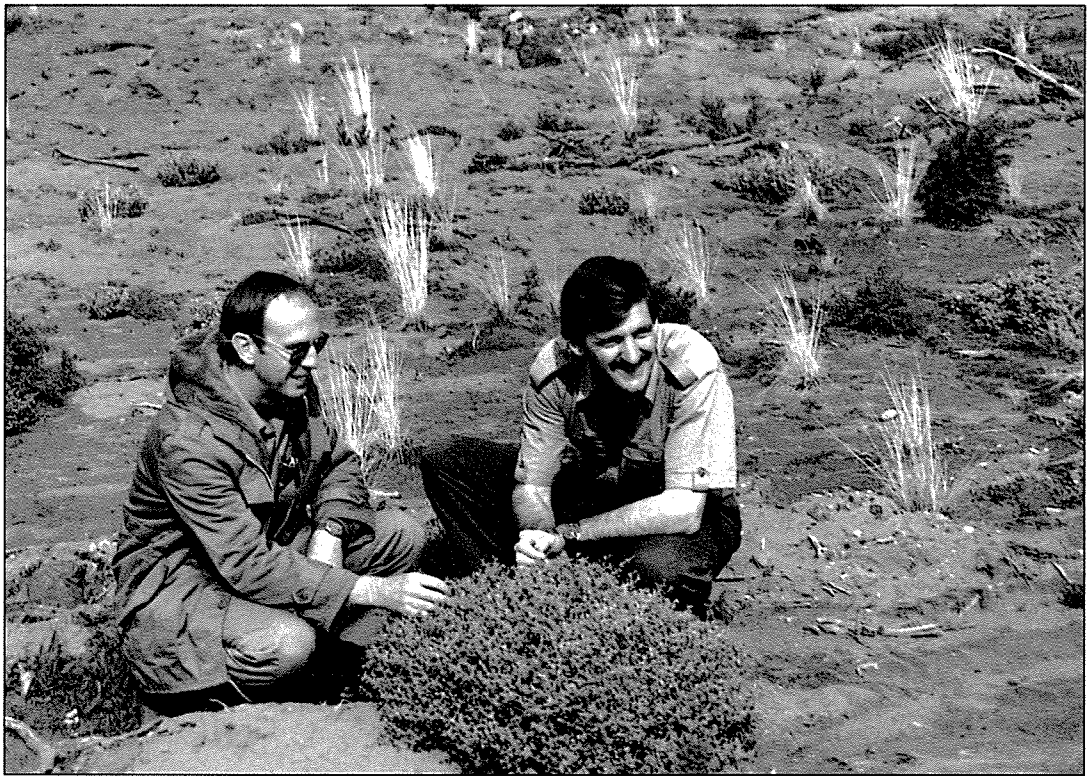
- The mineral and petroleum resources of the State are owned by the Crown, but are almost entirely explored for, and developed by, private enterprise.
- Exploration and development are undertaken in an organisational framework controlled and directed by Government with appropriate recompense (benefit) to the wider community.
- The mineral and petroleum industries play a major role in the economy of the State and a high level of exploration is essential to identify the mineral, petroleum and groundwater resources which will be

THE DEPARTMENT

RESPONSIBILITIES AND OBJECTIVES

required to sustain our economy and maintain our living standards.

- Mineral and petroleum deposits are almost always difficult and expensive to find, small in size relative to the total land mass, finite, and non-renewable.
- Mineral and petroleum deposits are assets only after they have been discovered and delineated, and the potential for an appropriate financial return provides the incentive to engage in high-risk exploration necessary to find them.
- Mineral and petroleum developments are a temporary land-use and should be integral to the principle of multiple land-use.
- Changes in the economy, technology, and geological understanding will lead to the reappraisal of previously tested ground; thus the potential of any area can never be totally written off and there is a need to ensure that information is not lost and as much land as possible is made available for exploration.
- Geoscientific data available from studying the geological record are essential for general land-use planning (for planning and designing urban areas, dams, roads, ports and harbours); such information can also assist in understanding and predicting events associated with the Greenhouse Effect.
- Chemical research and services at a high level of confidence and integrity are needed to ensure independent and standardised information is provided to the community.
- Management and the workforce must work together to create a safe working environment.
- Public safety is of major concern in relation to the transportation, storage and use of explosives and dangerous goods.
- Resources allocated to the Department are to be administered efficiently according to the



The Minister for Mines, the Hon Gordon Hill, viewing rehabilitation with the Department's Environmental Manager Keith Lindbeck at WMC's Kambalda nickel operations.

prevailing principles and standards expected of the Public Service.

- The Department must respond quickly and effectively to changes required by the community through Government.

It is against this background and in this environment that the Department must operate.

ROLE

The role of the Department is to ensure that the community of Western Australia:

- Receives maximum benefit from the responsible exploration for and development of minerals and petroleum with proper regard to the protection of the environment;
- Is protected from hazards associated with mineral and petroleum activities, explosives and dangerous goods;
- Has access to independent geotechnical, chemical and engineering advice relevant to land-use planning, groundwater management and the regulation of the mineral and petroleum industries;
- Is provided with information about the geoscientific environment including the distribution of mineral, petroleum and groundwater resources; and
- Is provided with independent chemical research, consultancy and analytical services.

PROGRAMS:

In its defined role the Department of Mines carries out certain programs, as follow:

1 **Minerals and Petroleum Titles Program**

The objective of this program is to ensure that exploration and development titles for minerals and petroleum are issued fairly and without delay.

1.1 Title System Sub-Program

Provides an equitable system for granting secure exploration and development titles as a basis for petroleum and mineral assessment and production.

1.2 Dispute Management Sub-Program

Minimises potential for disputes over exploration and development titles and facilitates the prompt settlement of disputes when they do arise.

2 **Exploration and Development of Natural Resources Program**

The objective of this program is to foster and assist responsible mineral and petroleum exploration and development, groundwater assessment, and land-use planning by providing high-quality scientific and technical services and advice to industry, Government and the public.

2.1 Geological Data Collection Sub-Program

Meets the need for geoscientific mapping, research, and resources assessment required to produce up-to-date maps, reports, and advice on the geology of the State and its mineral, petroleum and groundwater resources.

2.2 Metallurgical and Analytical Services Sub-Program

Provides mineral and metallurgical analytical and research services.

2.3 Geoscientific Data Dissemination Sub-Program

Provides timely dissemination of scientific and technical data from company exploration activities and Departmental studies.

2.4 Geotechnical and Mining Engineering Advice Sub-Program

Meets the need for geotechnical, geoenvironmental, hydrogeological, and mining engineering advice and services.

2.5 Community Relations Sub-Program

Fosters a favourable climate in the community for mineral and petroleum exploration and development.

3 Environmental Protection and Rehabilitation Program

The objective of this program is to ensure that proper attention is given to the protection and rehabilitation of the natural environment as it may be affected by mineral and petroleum exploration and development, and to facilitate the protection of groundwater resources.

4 Community Benefits Program

The objective of this program is to ensure that the community receives a fair return from the extraction of the State's mineral and petroleum resources.

5 Worker and Public Safety Program

The objective of this program is to ensure that all operations in the mining and petroleum industry, and activities involving explosives and dangerous goods, are conducted in a manner that is safe for workers and the public.

5.1 Workers' Safety and Health Sub-Program

Maximises the safety and health of workers in the mining and petroleum industry.

5.2 Management of Dangerous Goods Sub-Program

Minimises hazards to the public from activities involving explosives and dangerous goods.

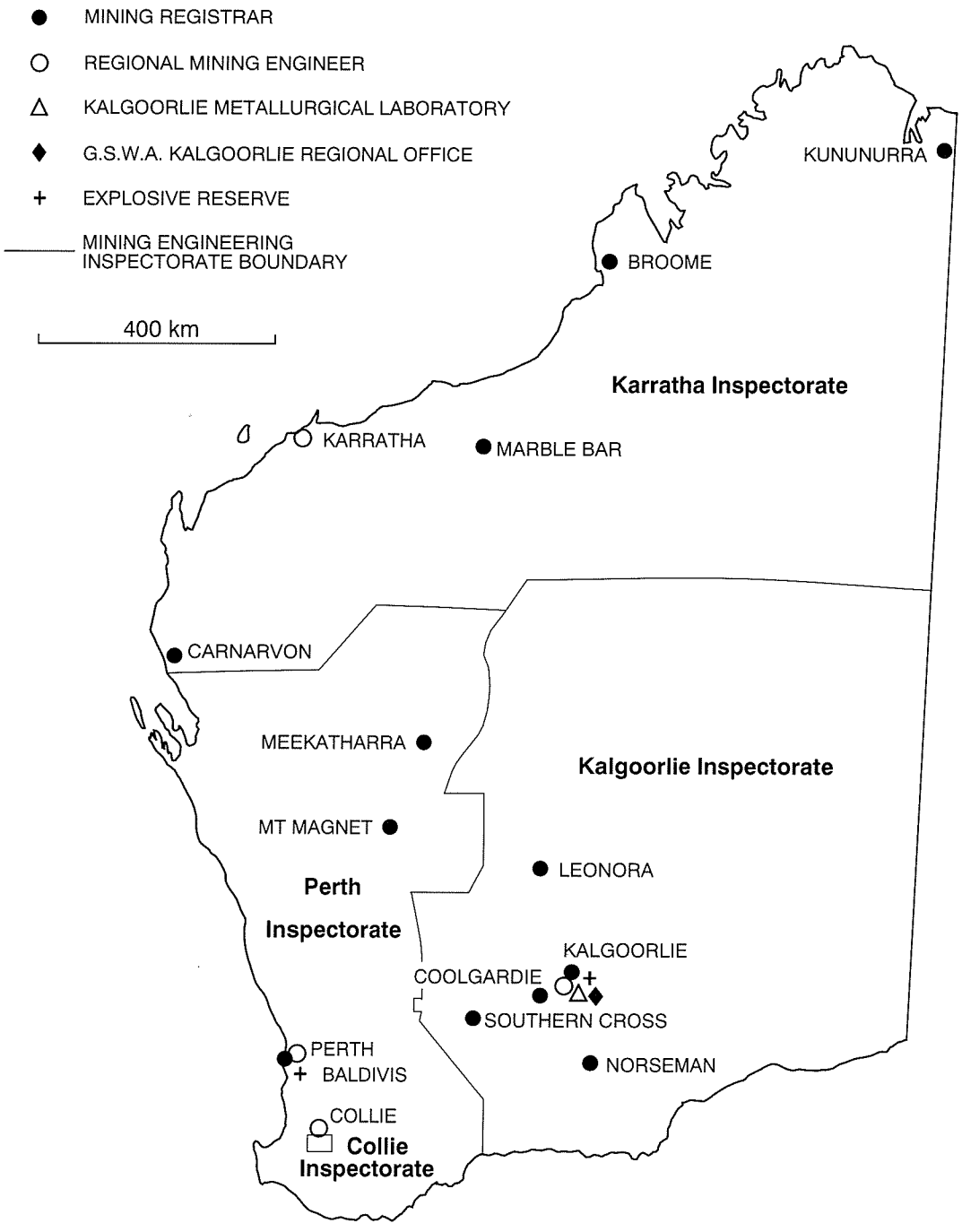
6 Chemical Services Program

The objective of this program is to enhance agricultural and industrial development, and the protection of community, consumer, environment and health standards by providing high-quality independent chemical services to Government, industry and the public.

7 Corporate Services Program

The objective of this program is to ensure that the human, financial and other resources of the Department are used efficiently and effectively to provide a service responsive to the needs of the community, industry and Government.

REGIONAL OPERATIONS



THE DEPARTMENT

ORGANISATIONAL STRUCTURE

Divisions of the Department

The Department of Mines is structured into nine divisions.

Activities of the divisions are targetted at achieving the objectives of seven programs. The matrix on pages 16 and 17 shows the divisions and the programs into which they have input.

The Geological Survey Division systematically records and interprets the geology of the State and provides this information to Government, industry and the general public in order to assist the exploration, development and conservation of the State's mineral, petroleum and groundwater resources.

It evaluates mineral and petroleum resources as a basis for decision-making by Government and assists and advises on a variety of community needs, including urban planning, land-use matters and engineering developments.

The Petroleum Division facilitates the undertaking by industry of geophysical and drilling programs for the identification and exploitation of oil and gas accumulations. It ensures that sound engineering principles and standards are applied to the design and construction of exploration and production facilities and that safety management systems are in place to secure the occupational health, safety and welfare of the workforce. It also maintains an effective title allocation and registration system, and monitors, advises and interprets State and Commonwealth petroleum legislation.

The Chemistry Centre (WA) provides chemical, mineralogical, metallurgical and associated analytical, investigative and advisory services to Government, industry and the public in the following areas: the development of the State's mineral, water and agricultural resources; monitoring and improving public and occupational health, environmental and material standards within the community; and scientific support to law enforcement and racing agencies.

The Royalties and Policy Development Division develops mineral and petroleum royalty systems which are fair and equitable and administers the collection and audit of royalties paid on behalf of the State and Commonwealth. It also provides economic advice on mining and petroleum industry issues, collects and disseminates statistics and assists in the development and co-ordination of general Departmental policies. The division informs staff, industry and the public about the role of the Department and the importance of the mining and petroleum industry.

The Corporate Development Division provides corporate services for the Corporate Executive and the divisions of the Department whilst responding to the requirements of Government and central agencies. These services include corporate planning, building and purchasing services, computing, typing, records, telecommunications, finance, human resource and auditing activities.

The Mining Engineering Division administers mine safety legislation to safeguard and promote the health and safety of those working in the industry. It provides advice to the Government and to industry on mining engineering matters including deep mining, open-cut mining, quarrying, drilling, the environment and rehabilitation. It monitors exploration safety and administers contract drilling for the Department.

The Explosives and Dangerous Goods Division reviews, formulates and administers laws, regulations and policies aimed at the safe manufacture, storage, handling and transport of explosives and dangerous goods. It provides safety advice on these matters and major hazard control.

The Mining Registration Division receives applications and allocates titles that give legal rights to explore for and mine minerals in

THE DEPARTMENT

ORGANISATIONAL STRUCTURE

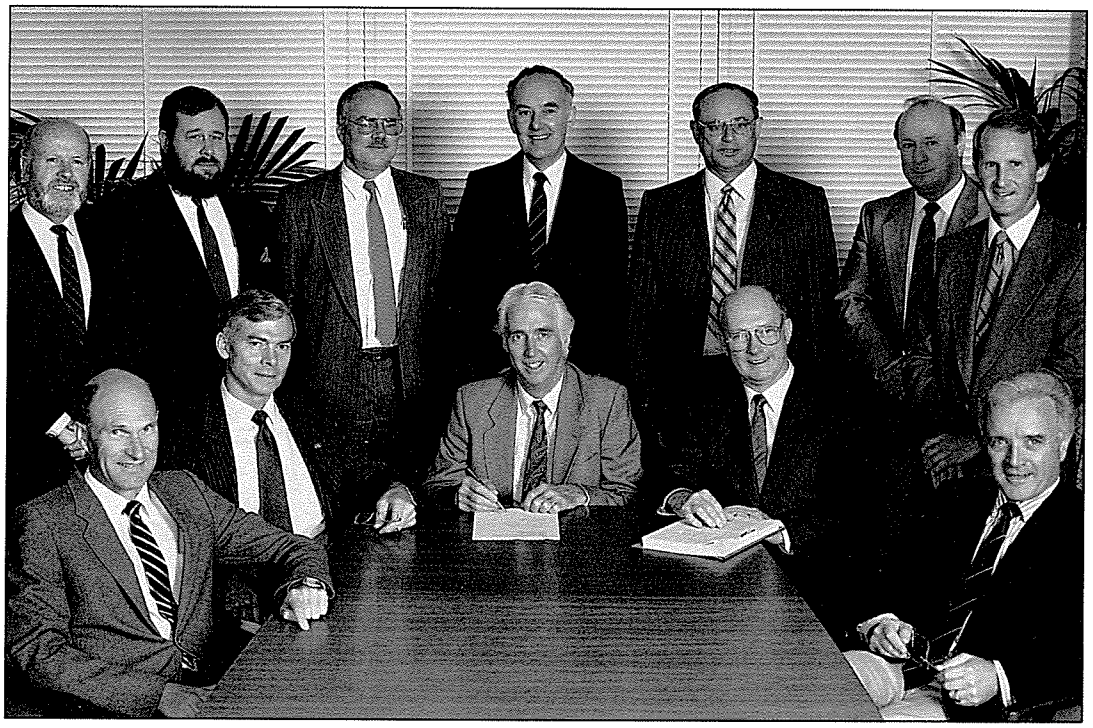
Western Australia pursuant to the Mining Act. It maintains a mining tenement registry which records tenement holders, conditions and term of the grant and expenditure details from which the division monitors compliance with the provisions of the Mining Act.

The Surveys and Mapping Division determines, documents and validates the boundaries of tenements and produces and updates all maps and plans necessary for the operations of the Department. All functions from primary field surveys to final map production are embraced. The range of cartographic activities includes charting, field surveying, computations, mapping reprographics, and maintenance of archival materials as an integral part of the tenement management process.

The officers of the Department are mostly located in Perth, although five divisions — Geological Survey, Mining Engineering, Chemistry Centre, Explosives and Dangerous Goods, and Mining Registration — have staff situated in regional centres. Most of these people work in areas that are large and remote by world standards.

In addition to providing services for land-based operations, the Department is also required to administer State and Commonwealth legislation covering offshore mineral, oil and gas exploration, exploitation, pipeline transportation and royalty payments.

A Department directory listing all offices is included in Appendix 6.



The Department's corporate executive: (standing from the left) Kerry O'Neil, John Clarke (deputising for the Director of the Geological Survey Phil Playford), Bill Phillips, John Hosking, Jim Torlach, Les Annison and Murray Meaton. Seated are Ken Price, Lee Ranford, Des Kelly, Colin Branch and Ian Fraser.

DIVISIONAL ACTIVITIES TO MEET CORPORATE OBJECTIVES

PROGRAM	SUB-PROGRAM	GEOLOGICAL SURVEY	MINING ENGINEERING	PETROLEUM
MINERALS & PETROLEUM TITLES **1** To ensure that exploration and development titles for minerals and petroleum are issued fairly and without delay.	1.1 Provide an equitable system for granting exploration and development titles as a basis for petroleum and mineral assessment and production.	Provide technical advice in relation to administration of Petroleum and Mining Acts.		Award, maintain and monitor rights to explore and develop petroleum onshore and offshore.
	1.2 Minimise potential for disputes over exploration and development titles and facilitate the prompt settlement of disputes when they do arise.	Technical advice or tenement matters.	Technical advice on tenement matters.	Process dealings, assess fees and advise on legislation.
EXPLORATION & DEVELOPMENT OF NATURAL RESOURCES **2** To foster and assist responsible mineral and petroleum exploration and development, groundwater assessment, and landuse planning, by providing high-quality scientific and technical services and advice to industry, Government and the public.	2.1 Meet the need for geoscientific mapping, research, and resource assessment required to produce up-to-date maps, reports and advice on the geology of the State and its mineral, petroleum, and groundwater resources.	Obtain, interpret and evaluate data on all aspects of geoscience and earth-based resources (mapping, data, collation, evaluation).	Administer contract drilling to support resource assessment.	Provide technical and advisory services to ensure efficient and effective oil-field practice in exploratory and development drilling, testing and production.
	2.2 Provide mineral and metallurgical analytical and research services.			
	2.3 Provide timely dissemination of scientific and technical data from company exploration activities and Departmental studies.	Publish information and maintain geoscientific databases.	Publish reports and guidelines.	Provide information and statistics on petroleum exploration and development.
	2.4 Meet the need for geotechnical, geoenvironmental, hydrogeological, and mining engineering advice and services.	Provide advice and prepare special maps.	Ensure that effective mining engineering advice is available as required.	Advise on oil and gas volumes, field behaviour and production techniques to ensure optimum production and conservation of resources.
	2.5 Foster a favourable climate in the community for mineral and petroleum exploration and development.	Inform and advise Minister, and liaise with industry. Aboriginal and other community groups.	Ensure mineral exploration and mining operations meet community standards.	Develop strategies to encourage a strong and active oil and gas industry.
ENVIRONMENTAL PROTECTION & REHABILITATION **3** To ensure that proper attention is given to the protection and rehabilitation of the natural environment as it may be affected by mineral and petroleum exploration and development, and to facilitate the protection of groundwater resources.	• Ensure protection and rehabilitation of the natural environment as it may be affected by mineral and petroleum exploration and development.	Review and advise on environmental and/or rehabilitation aspects of exploration and mining proposals.	Ensure protection and rehabilitation of the environment as it may be affected by mineral exploration and development.	Implement audit procedures to ensure industry commitment and compliance with environmental requirements.
	• Facilitate the protection and rehabilitation of groundwater resources.	Provide hydrogeological advice on groundwater contamination.	Ensure drilling and tailings dams are managed to minimise groundwater contamination.	Ensure oil drilling operations do not pollute underground water resources.
	• Provide chemical services for environmental management.			
	• Provide geology and mineral resource information and advice for planning and management of National Parks and conservation reserves.	Provide geoscientific advice for landuse planning.		Advise on petroleum prospectivity and possible development methods for environmentally sensitive areas.
COMMUNITY BENEFITS **4** To ensure that the community receives a fair return from the extraction of the State's mineral and petroleum resources.	• Ensure that royalty collection is carried out in an economically and administratively efficient manner.	Provide geological advice to assist royalty determination.	Inspect mineral projects to assist with royalty determination and collection.	Ensure standards are met for oil and gas metering systems, and for the measurement of petroleum quantity and composition.
WORKERS & PUBLIC SAFETY **5** To ensure that all operations in the mining and petroleum industries, and activities involving explosives and dangerous goods, are conducted in a manner that is safe for workers and the public.	5.1 Maximise the safety and health of workers in the mineral and petroleum industries.	Provide geotechnical advice relating to mine safety.	Ensure compliance with the Act and Regulations by regular inspections, training and advice in mineral exploration and metalliferous and coal mines.	Carry out audits and safety inspections of petroleum operations; provide technical advice on exploration and development proposals and plant modifications.
	5.2 Minimise hazards to the public from activities involving explosives and dangerous goods.		Ensure public safety at abandoned mines.	Ensure the design, installation and operations of licenced petroleum pipelines comply with approved safety standards.
CHEMICAL SERVICES **6** To enhance agricultural and industrial development, and the protection of community, consumer, environmental and health standards, by providing high-quality independent chemical services to Government, industry and the public.	• Agricultural chemistry services; • Forensic science services; • Environmental chemistry services; • Public and occupational health chemistry services; • Materials and consumer protection scientific services; • Racing chemistry services.			

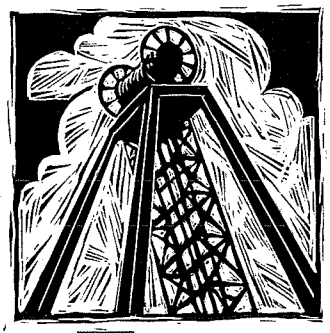
THE ORGANISATION

DIVISIONAL ACTIVITIES

CHEMISTRY CENTRE W.A.	EXPLOSIVES & DANGEROUS GOODS	MINING REGISTRATION	SURVEYS & MAPPING	ROYALTIES & POLICY DEVELOPMENT
		Award, maintain and monitor rights to explore and mine minerals onshore and offshore.	Provide and maintain maps depicting all mining and petroleum tenure and other land tenure; provide public searching facilities; record and certify position and other land tenure status of tenements; and manage surveying operations to establish tenement boundaries.	
		Operate Warden's Court and process Ministerial Appeals, Monitor effectiveness of legislation.	Provide a means of resolving conflict arising in respect to tenement boundaries, positions or markings.	
Provide chemical, mineralogical, analytical and advisory services on minerals and water.		Monitor performance of tenement holders in the submission of geoscientific reports.	Provide supporting geographical information systems.	
Provide chemical, extractive metallurgical and mineral processing advisory services and undertake investigations to enhance the processing of minerals.				
		Record and publish tenement data for industry.	Provide a cartographic and map preparation facility.	
Provide analytical and advisory services on groundwater, ores, mining and mineral processing.			Provide a cartographic and map preparation facility.	
Develop and monitor new technology appropriate to further processing of minerals.		Liaise with industry.		Inform Government and community.
Inspect, investigate and advise on environmentally sensitive areas, including mine wastes.		Issue and monitor titles with due regard to protection and rehabilitation of the environment.	Provide a graphical index and record of environmental themes.	
Provide chemical advice on the protection and rehabilitation of groundwater.	Ensure that dangerous goods are transported in a manner that provides maximum protection to the environment.			
Analyse and identify contaminants and natural constituents in air and water. Provide soil testing services for soil conservation projects.				
Provide chemical and mineralogical analytical services on geological materials.			Monitor changes to Environmental Reserve boundaries and maintain graphical systems.	
			Support the site location data base.	Collection of royalties and statistics.
Inspect, test, investigate and advise on occupational health matters.			Provide a repository for information concerning plans of mines and minesites.	
Inspect, test, investigate and advise on chemical aspects of dangerous goods, handling, storage and transport.	Provide a high level of assurance of public safety at places where explosives and dangerous goods are manufactured, stored or transported.			
Undertake investigations, solve problems and provide scientific support, for agricultural research and regulatory programs; for law enforcement and drug free racing; for protection of community health, consumer and environment standards, and for the support of chemical industry.				

CORPORATE SERVICES

7 To ensure that the human, financial and other resources of the Department are used efficiently and effectively to provide a service responsive to the needs of the community, industry and Government.
(Affects all programs.)



THE MINING AND PETROLEUM INDUSTRY

THE YEAR IN REVIEW

WESTERN AUSTRALIA

Expansions and new developments initiated during the boom conditions of the last three years carried the industry's strong performance through 1990-91, despite declining financial results being posted by many producers.

The total value of mining and petroleum production for the financial year is estimated at $12.3 billion, an increase of over $1.8 billion (18%) on the previous financial year. This is an impressive result given the poor economic conditions prevailing in the rest of the economy.

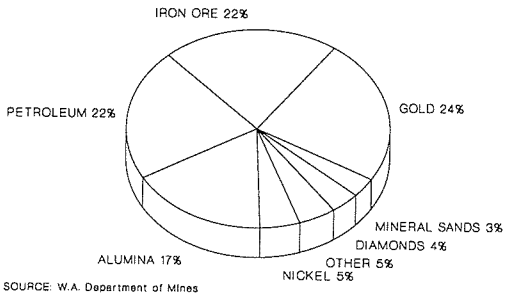
The petroleum sector again provided the most significant increase — $1.1 billion or 73% more than last year.

Buoyed by shipments of natural gas, the petroleum sector has now become the State's fourth $2 billion per year industry, along with iron ore, gold, and alumina. Together these four sectors contribute nearly 85% of the State's total value of production. The diversity is important in "cushioning" the State from the adverse effects of a downturn in one or two major commodities.

At a time when most other industries and the overall economy are severely depressed, the relative well-being of Western Australia's mining and petroleum industry has highlighted the strength of its base, its diversity and added further to its importance and, indeed, dominance of the State's economy. Perhaps this importance has contributed to mining becoming the focus of attack from various sectors of our community on questions of land access and conservation. The news has been dominated by such issues during the year, while the economic value of the mining and petroleum industry has been overlooked or, at least, taken for granted.

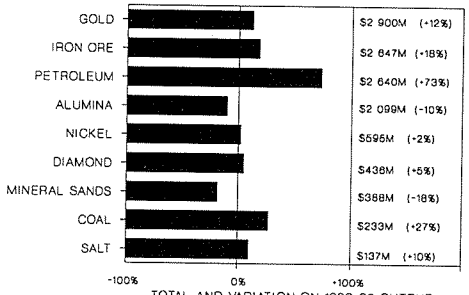
Some significant development projects are being delayed by conservation and land access issues, while, in a number of areas of the State, access for exploration is being held up. Exploration is the lifeblood of the mining and petroleum industry. It not only provides a foundation for future growth, but more importantly it is essential to maintain existing production levels. It is encouraging to note that the rapid downward trend in mineral exploration expenditure of the past three years

1990-91 VALUE OF MINERAL & PETROLEUM PRODUCTION
TOTAL: $12,269 MILLION (est)



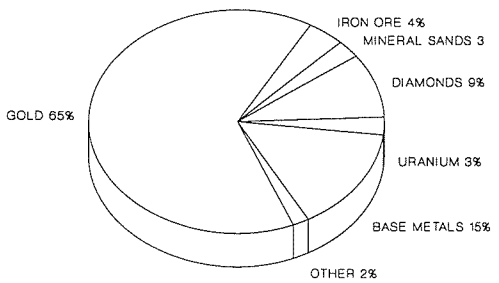
SOURCE: W.A. Department of Mines

CHANGE IN VALUE OF PRODUCTION
1990-91 (MAJOR SECTORS)



SOURCE: W.A. Department of Mines

MINERAL EXPLORATION EXPENDITURE
1990-91

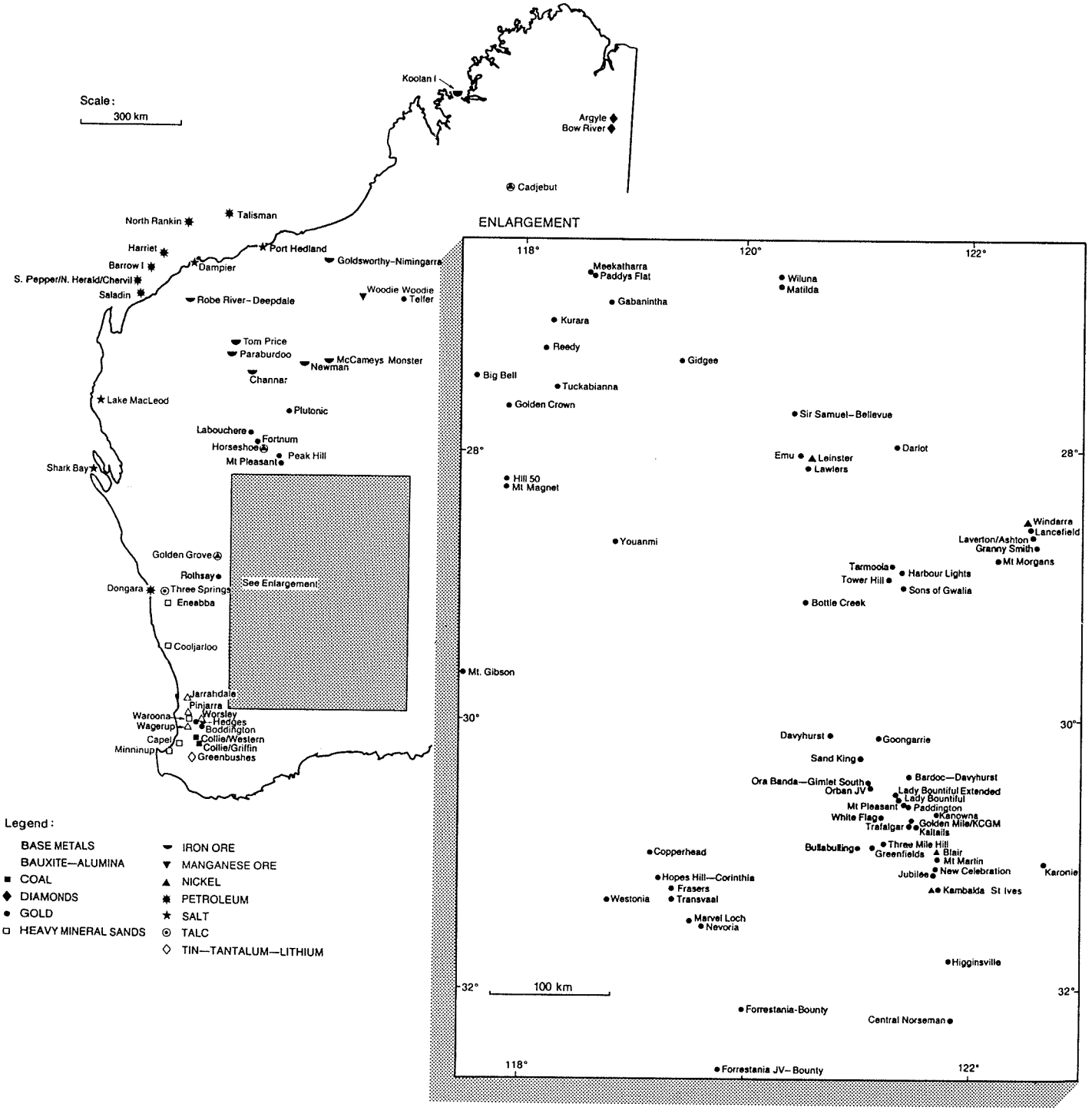


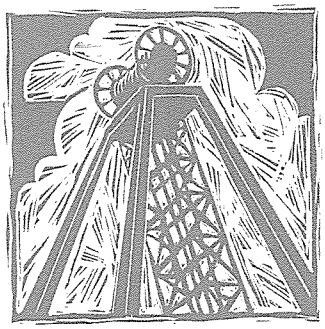
SOURCE: A.B.S. Private Mineral Exploration Expenditure

THE MINING AND PETROLEUM INDUSTRY

THE YEAR IN REVIEW

MAJOR MINERAL AND PETROLEUM PROJECTS IN WESTERN AUSTRALIA
with an annual value of production in excess of $10 million

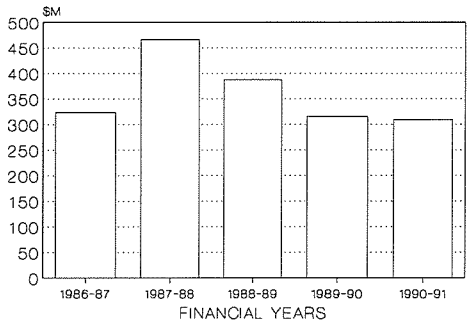




THE MINING AND PETROLEUM INDUSTRY

THE YEAR IN REVIEW

W.A MINERAL EXPLORATION EXPENDITURE
1986-87 TO 1990-91



has largely been arrested. Mineral exploration expenditure for 1990-91 is expected to be down about 4% to about $310 million on the previous year, mainly attributable to lower activity in gold which continues to dominate (65% of the State total). For most other minerals, exploration expenditure has shown an increase. Petroleum exploration activity has continued to ride on the remarkably high discovery rates of 1989 and 1990, with about $250 million being invested in exploration (about the same as last year), but with development drilling and new development activity showing a substantial boost.

THE INTERNATIONAL CONTEXT

Sharply lower inflation in Australia provided added competitiveness and a reasonably constant exchange rate had a stabilizing effect on the State's mining industry in relatively difficult world commodity markets. However, high domestic interest rates have been instrumental in keeping the exchange rate artificially high, thus adversely affecting mineral revenue.

Being export-dominated, the Western Australian industry is dependent on the vagaries of the world market and hence world economic activity. While overall, a slow rate of economic growth was maintained in 1990-91, two important markets for Western Australian products, the USA and UK, slipped into recession. Two others, Japan and Germany, maintained reasonably strong growth until the last quarter. Market views have recently been expressed that, for a number of commodities, demand and price have bottomed out, but for others a continued downward trend is expected in 1992. However, it is generally true that having come from exceptionally high levels in the 1988-90 period many commodities are, in an overall context, back to demand and price levels which reflect long-term price trends. To date the minerals industry would appear to have missed the most severe effects of the world economic recession.

COMMODITY AND OPERATIONS REVIEW

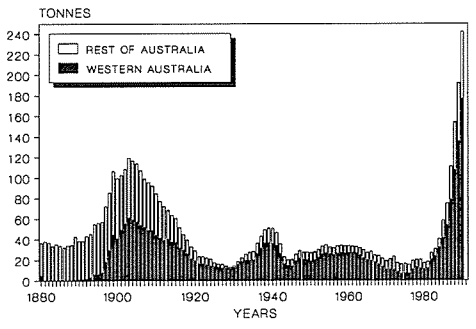
The following sections analyse the major commodities produced in Western Australia and review the main operations.

GOLD

Gold production in 1990-91 showed further significant growth over the previous year. Output was estimated to be 181 tonnes, an increase of 22% on 1989-90. Accelerated production prior to the introduction of company taxation on gold from January 1991 was a major factor in this increased output. Production increased by 2-3 tonnes per quarter over an 18-month period prior to 1991, to suddenly drop 6 tonnes in the March quarter of 1991.

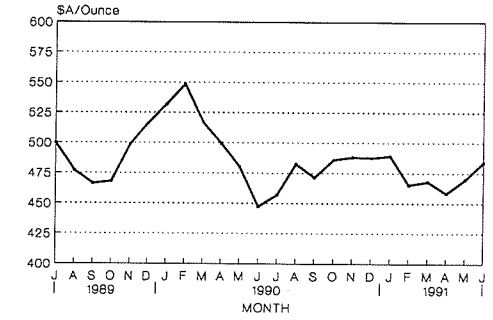
The average gold price of $A497 per ounce

GOLD PRODUCTION



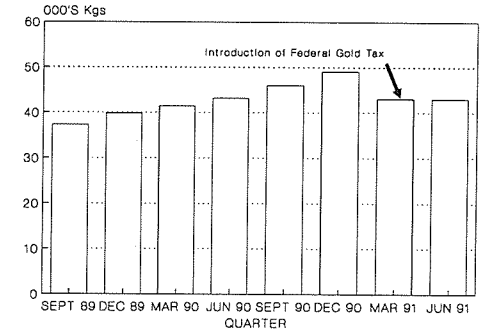
SOURCES:DEPT OF MINES WESTERN AUSTRALIA, BMR & ABARE

GOLD PRICES



SOURCE: London Gold Price, Monthly Average of Wednesday Prices.

QUARTERLY GOLD PRODUCTION



SOURCE: W.A. Department of Mines

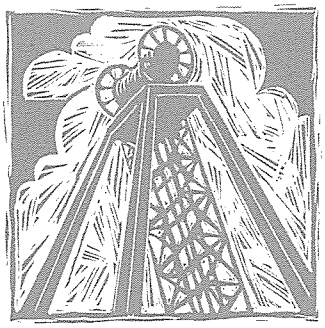
for 1990-91 was the same as the previous year and was relatively stable throughout the year. The increased production for the year resulted in an estimated value of production of $2 900 million based on average monthly international gold prices. Given forward sales in place by a number of producers, this would probably mean realisations well in excess of $3 000 million. In value terms, this maintains gold's position as the principal mineral produced in Western Australia.

About 52% of the State's total gold production, came from the Eastern Goldfields province. Kalgoorlie Consolidated Gold Mines Ltd's (KCGM) combined operations on the *Golden Mile* was the largest single production unit. A combined production of 17.3 tonnes of fine gold was recorded in 1990-91. *Kambalda - St Ives*, with 9.2 tonnes of gold produced, was the second largest operation in the province, with the large low grade *Granny Smith* operation, which commenced production in January 1990, third with 6.7 tonnes of gold produced. A further five operations in the region (*Mt Morgans, New Celebration, Wiluna, Leinster-Emu, Bellevue*) produced more than 3.1 tonnes for the year.

Boddington, 120 km south-east of Perth, was the second largest producer in the State, with 13.2 tonnes, but in combination with *Hedges*, a separate operation on the same deposit, exceeded the combined KCGM output by about 100 kg of fine gold. *Telfer*, the other operation outside of the traditional goldfields' mining regions, featured third with 9.7 tonnes. The impressive Telfer result was due to diversified production covering the standard CIL operation, a major expansion of low-grade heap leaching, and exploitation of supergene-enriched high-grade copper-gold ores from underground.

In August 1990 the *Plutonic* operation in the Marymia Dome, north of Meekatharra, commenced production initially at a very high rate on high-grade surface ores. Up to the end of 1990, a total of 3.9 tonnes of gold was produced. The rate was subsequently reduced as lower grade material was treated to record 7.2 tonnes for the whole year. Of the Murchison province producers, Hill 50's (WMC) integrated operation at *Mt Magnet* and *Big Bell*, near Cue, was the strongest performer in the region, producing 24.7 tonnes. The Southern Cross province produced 16.4 tonnes with Forrestania Joint Venture's *Bounty* operation, which went underground during the year, being the major producer.

A list of the top 20 producers in Western Australia appears in the following table:



THE MINING AND PETROLEUM INDUSTRY

THE YEAR IN REVIEW

Ranking	Project	Production (kg of fine gold)
1	Golden Mile/KCGM	17 303
2	Boddington	13 196
3	Telfer	9 701
4	Kambalda-St Ives	9 228
5	Plutonic	7 172
6	Granny Smith	6 759
7	Hill 50-Mt Magnet	6 490
8	Hedges	5 420
9	Big Bell	3 766
10	Mt Morgans	3 645
11	New Celebration	3 464
12	Wiluna	3 430
13	Leinster (Emu)	3 427
14	Sir SamuelJV-Bellevue	3 318
15	Forrestina JV Bounty	3 105
16	Paddington	3 005
17	Mt Pleasant JV	2 840
18	Lancefield	2 826
19	Sons of Gwalia	2 640
20	Meekatharra/Dominion	2 590

Extensive takeovers and integrations over the last three years were thought to have more or less fully rationalised the industry by 1990. However, subsequent takeover activities have further consolidated operations, notably in the Meekatharra, Mt Magnet and Southern Cross-Marvel Loch areas. At Meekatharra, Dominion Mining Ltd has brought its Gabanintha operation into the group of mines feeding the central Paddys Flat plant, while St Barbara Mines Ltd has taken over Metana Minerals' projects at Yaloginda and Highway to maintain longer term feed to its nearby Bluebird plant. In the Mt Magnet area, Hill 50 Gold Mine NL completed the purchase of Metana's Mt Magnet-Lennonville operations and commenced rationalizing and integrating all operations. Built on successful gold operations elsewhere in the State, Reynolds Australia Metals Ltd took ownership control of the Marvel Loch - Transvaal operations, and Samantha Gold NL of the Hopes Hill-Corinthia operations, both in the Southern Cross area.

Many operations now depend on more distant 'satellite' orebodies to maintain feed to existing centralised plants and the unit costs of many other operations have significantly increased, with the depletion of cheaply won, near-surface orebodies which acted as 'sweeteners' to more costly harder ores and underground operations. Noted casualties of these and similar problems include the major cut-back of production at Norseman, the imminent closure of the final underground operations on the Golden Mile, and the closure within 12 months of start up of Rothsay in the Murchison.

In a number of areas the longer term future of many of the operators is seen in underground exploitation by decline from within existing pits and associated treatment of sulphide ores. Trial underground operations have already commenced at the Main Dome at Telfer and at New Celebration, near Kambalda, and very significant output has recently started from the Junction underground orebody at Kambalda - St Ives. Both Pancontinental Mining and Newcrest Mining at Paddington and Gimlet South (Ora Banda) respectively are giving serious consideration to underground development.

An exception to this trend is KCGM's Golden Mile operations, where the development of the 'Superpit' has seen the closure of all Fimiston underground mines except the Chaffers shaft. Chaffers is scheduled to close by June 1992, leaving only the highly mechanised, cost-competitive *Mt Charlotte* operation as the sole underground producer at Kalgoorlie-Boulder.

A significant proportion of gold exploration effort is geared to identifying and evaluating further reserves at operating mines to maintain feedstock to existing plants. Reconnaissance exploration is certainly less active than a few

years ago, although 'greenfields' areas like the Marymia Dome, to the north of Meekatharra, and the Telfer region are still attracting considerable attention. As a result the large number of stand-alone 'greenfields' projects identified through the mid-1980s has largely disappeared, although some significant discoveries continue to be made. A number of these are adjacent to existing operations and include the *Challenge* prospect at Higginsville, the *Conqueror* lode system below Victory - Defiance at Kambalda and an estimated half-a-million ounce low grade inferred resource at *Big Tree*, about 23 km south-east of Telfer. *Yilgarn Star*, south-east of Marvel Loch, has a moderate sized identified resource and is being developed as a new stand-alone project, although utilising plant acquired from the failed Great Victoria operation. The most significant find to fully emerge during the year is *Kanowna Belle*, just 2 km from the existing QED operation. A very large resource of 1.8 million ounces at an average grade of 5 g/t has been delineated.

While total gold exploration expenditure in the State in 1990-91 was estimated to have declined by 7% on the previous year, to $200 million, its drop was substantially less than for the previous two years and still remains well above the levels of the first half of the 1980s, when the current boom started. Gold exploration still contributes a major share (65%) of the total mineral exploration budget. For the State to maintain gold production levels into the future, exploration expenditure will need to be sustained at least at current levels.

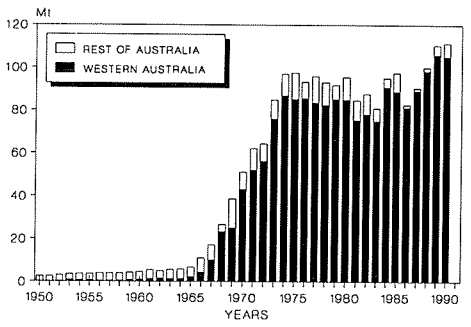
IRON ORE

A high level of iron ore shipments by all operators was maintained during the year, reaching 107.5 million tonnes which exceeded last year's by 1 million tonnes. With the 16% price rise applying for the April 1990-March 1991 ore year and a further 6 - 8% negotiated for April 1991, this effectively increased the value of shipments for 1990-91 by about 18% to nearly $2 650 million.

Whereas the economic downturn has, to varying degrees, affected all other mineral commodities over the last year, the world iron ore market has remained strong, particularly in Japan and other South East Asian countries which are the principal consumers of Western Australian iron ore. The overall fall in steelmaking demand has been largely offset by supply problems experienced by export competitors in other parts of the world, thus maintaining a relatively tight iron ore supply-demand situation.

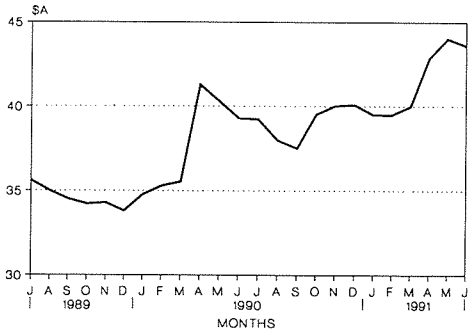
With South Korea, Taiwan and China continuing as major growth areas of steel production, and with a relatively strong Japanese steel sector, the longer term future of the Western Australia iron ore industry appears to be relatively bright and investment

IRON ORE PRODUCTION

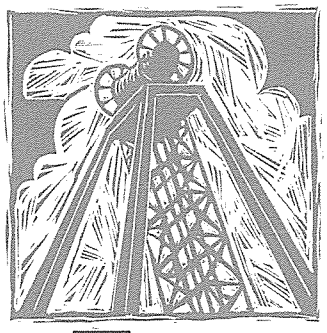


SOURCES:DEPT OF MINES WESTERN AUSTRALIA, BMR & ABARE

IRON ORE PRICES: $A/tonne



SOURCE: HIGH GRADE LUMP ORE PRICES.



in existing and new projects is strong across the whole industry.

Hamersley Iron Pty Ltd continues as the major producer with operations at Tom Price, Southern Plains, Paraburdoo and its joint venture with China Metallurgical Import and Export Corporation at Channar. Shipments were 41 million tonnes, some four million tonnes below last year's record, but ore production of 46 million tonnes was near to design capacity and allowed replenishment of largely depleted stockpiles.

In order for the company to maintain the proportion of the much sought-after Brockman lump ore in its sales, it embarked on a second scree development at the *Brockman No. 2 Detritals* project, 54 km north-west of Tom Price. This project is designed to produce 4 million tonnes per annum of lump ore from mid-1992. A rail spur is designed to link the deposits to the main Tom Price - Dampier railway.

Further exploration effort by the Hamersley group is being concentrated on the evaluation of scree and detrital ore occurrences in the search for further high-grade, low-phosphorus lump ores, a rapidly diminishing resource from existing operations. Significant work is being undertaken on the Turner Syncline, to the west and north-west of Tom Price and over a 450 km strike length along the front of the Hamersley Ranges adjacent to the Fortescue River Valley.

In planning for the depletion of high-grade reserves at Tom Price over the next 10 years or so, Hamersley Iron has initiated development plans for its *Marandoo* deposit. In February 1991 it formalised the purchase of the 50% ownership of this deposit and others from its partners Hancock and Wright, to assume full control of Marandoo. After 20 years of exploration, evaluation and promotion of the deposit, only very recently has the issue of Aboriginal sacred sites been raised as a potential deterrent to development. Clearance is presently holding up a development schedule designed to bring the project into production by early 1994. Over the project life a production level of between 10 and 15 Mtpa is planned. A spur line will link the deposit to the Tom Price - Dampier railway and is seen as the first leg of an access corridor through the Hamersley Range National Park, which would allow the large resources in the central Hamersley Ranges to be linked to a western outlet route.

Preliminary proposals are being developed for a third new project to use the Hamersley railway - Dampier port facilities. Pilbara Port, Railroad and Resources Company (Hancock group) is proposing to develop detrital deposits above *Bee and Wittenoom Gorges*, to the south of Wittenoom.

BHP-Utah Iron Ore recorded a much improved performance from its *Newman* operations, with almost 30 million tonnes being shipped, plus a further two million tonnes from the *McCamey's Monster* scree operation. This is 4 million tonnes higher than the previous year, when operational problems hampered shipments.

Mobilisation for the construction and pre-production development phase of the *Marillana Creek* project commenced in February 1991. Initial mining and civil earthworks are underway, with production start-up scheduled for March 1992. A spur line through Fig Tree Gully will link the deposit to the company's Newman to Port Hedland railway. The initial planned production rate is up to 5.5 million tonnes per annum of Robe pisolites, with eventual output going up to 10 million tonnes per annum given market demand.

As with Hamersley's Marandoo rail link, the Marillana Creek rail spur is also seen as the first phase of perhaps a longer term link up to tap BHP-Utah Iron Ore's huge iron ore resources in

the *Goldsworthy Mining Area C* deposits and others within the central Hamersley Ranges.

The company's *Goldsworthy* operations, in the north Pilbara, crushed and railed at an effective rate of about 7 million tonnes per annum for 6.8 million tonnes of product; while at *Koolan Island* a satisfactory shipment level of 3.4 million tonnes served both BHP steelmaking plants and export markets. Koolan Island reserves are expected to be depleted by mid-1993.

The *Robe River* operation again achieved new record shipments of over 24 million tonnes for the year. The company has completed its operations on the original areas in the Pannawonica area and a large part of the production is now sourced from Deepdale Deposit "K". Planning is in place for the development of Deepdale "M" and "J" deposits. Robe River Iron Associates are making significant investments in mine, railway and port facilities to lift operations to over 30 million tonnes per year in the next few years.

Overall there is a degree of optimism in the industry, with a new phase of developments on deposits which have largely been known, evaluated and promoted for the last 20 years. A demonstrated resource of nearly 15 000 million tonnes with grades and qualities acceptable in today's market, forms a firm base to support a long term expanded industry in the Pilbara region, given the right climate for investment and development.

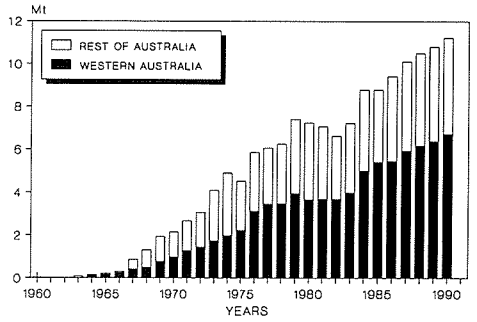
The development of steelmaking and/or ironmaking has long been the goal of progressive governments in Western Australia. A small number of mini-mill direct reduction/steelmaking projects are being promoted at the present time, but only the major *HISMELT* project has been committed, with a $200 million 'pilot' plant planned for Kwinana. The government has initiated a study, under the chairmanship of former minister Gavan Troy, to investigate the various opportunities for iron and/or steelmaking developments in Western Australia.

ALUMINA

Four years of boom conditions have generated an alumina oversupply on world markets. The introduction of additional alumina capacity has created an imbalance between aluminium metal and alumina. This, together with a build up of aluminium inventories as demand slows down with the general worldwide economic recession, has resulted in a realignment of alumina supplies with aluminium capacity and, more dramatically, a reduction in prices. Spot alumina prices at June 1991 were half the equivalent price of a year ago.

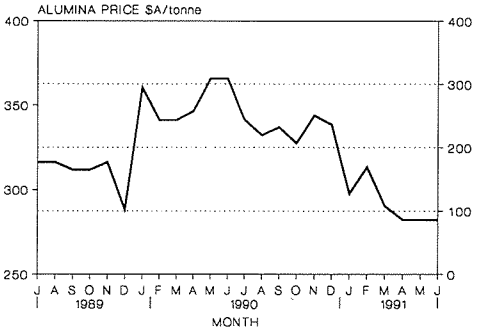
Western Australia is a low-cost alumina producer and should avoid the short term

ALUMINA PRODUCTION

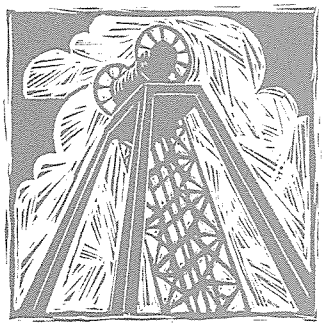


SOURCES:DEPT OF MINES WESTERN AUSTRALIA, BMR & ABARE.

ALUMINA PRICE



SOURCE: ABARE Average Alumina Price.



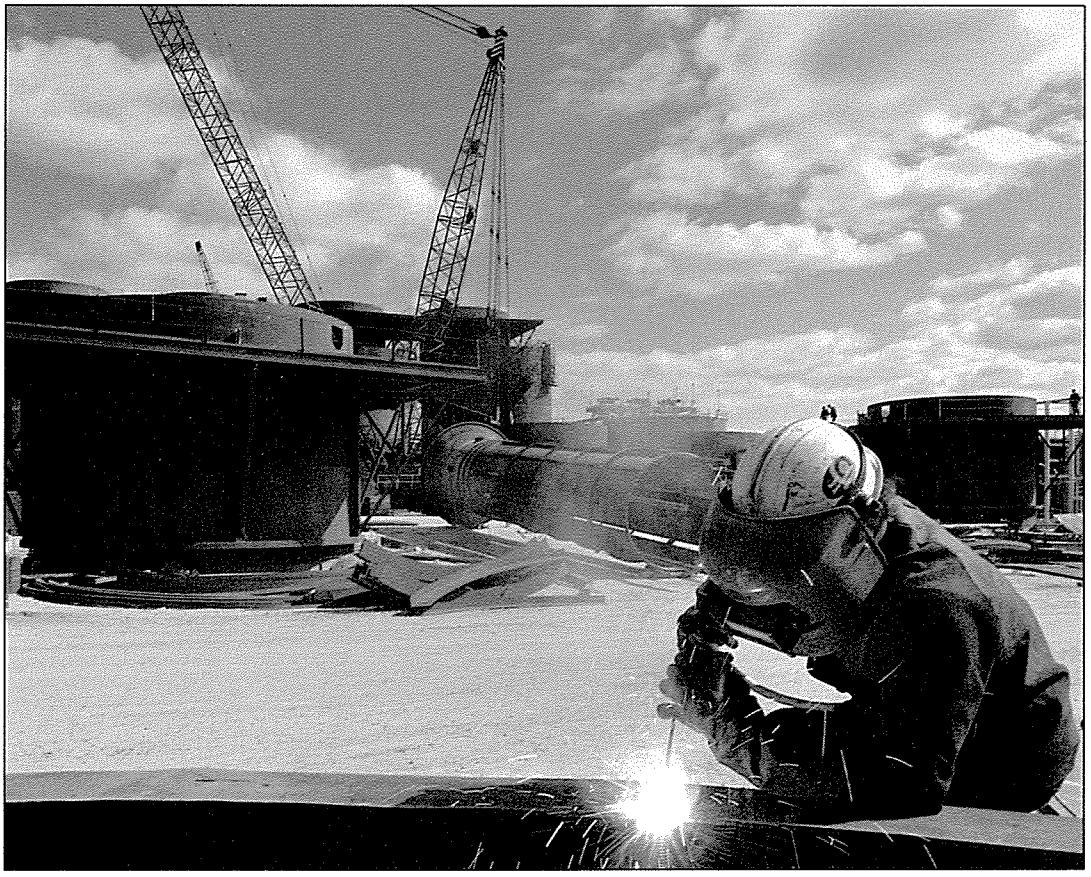
casualties that this downturn has generated. Forecasts are for a much improved situation by the end of 1991 and for the longer term. This augurs well for a Western Australian industry which is in various stages of increasing capacity.

The incremental increases in plant capacity and high operating levels throughout the Western Australia alumina industry resulted in a 2% or 130 000 tonnes increase in production over the previous year to record a total of 6.8 million tonnes. However, the industry did not escape the downward trend in prices, with an overall revenue drop of nearly $300 million or 12%, to $2 060 million for the year. This represents an average price drop of $50 per tonne to $300 per tonne with long- and medium-term contracts providing a cushion from the dramatic drop in the spot market-price, *Alcoa of Australia's* posted profits for the second half of the year were 46% down on the first half, but put into context, profits for 1990-91 overall were $600 million, indicating the extraordinary profitability for 1989 and 1990.

After a considerable period of evaluation, Alcoa committed itself in October 1990 to double the capacity of its *Wagerup* refinery. At a cost of $340 million and with a 30 months' construction period, the refinery will be expanded to 1.48 Mtpa of alumina and will create over 100 new jobs once in production.

The 18-month program of upgrading equipment and 'debottlenecking' at the *Worsley* operation will be completed in late 1991. At a cost of $104 million, capacity will have been raised to 1.5 Mtpa alumina. The Joint Venture is also studying the feasibility of constructing a third unit at the Worsley refinery to further boost capacity by 50%.

Partly to replace imports, but predominantly



Part of the $340 million expansion of Alcoa's Wagerup alumina refinery.

to supply export markets, Doral Resources has established a joint venture with a Japanese abrasives company to produce high quality, refractory grade fused alumina. The plant is under construction at Kwinana at a cost of $12 million and should be completed in September 1991 to produce 10 000 tpa of white fused alumina with an earning capacity of about $12 million per year.

A total of 8 000 kg of *gallium* was produced in the first quarter of the year before the extraction plant at the Pinjarra alumina refinery was shut down on account of the depressed world market.

PETROLEUM

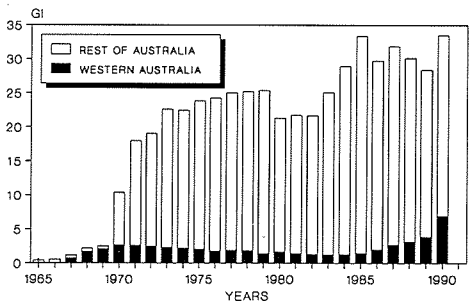
The spectacular growth in the petroleum sector continued in 1990-91. In addition to the progressive build-up in liquefied natural gas (LNG) exports (up 78% on 1989-90), both oil and condensate production was significantly increased (by 30% and 17% respectively). These production increases, together with substantial price rises, saw the total value of petroleum products increase by 73% on the previous year, to $2 640 million. This included $1 054 million from oil, $836 million from LNG, $379 million from domestic sales of natural gas and $371 million from condensate.

While the massive North West Shelf project has had the biggest impact on this growth, the significance of the many recent oil discoveries and subsequent developments in the northern Carnarvon Basin should not be underestimated. The sector has grown from six developed and four producing oil and gas fields in the State in 1982, to 17 producing fields by June 1990 and to 26 developed (of which 22 are producing) fields in 1991. This growth is set to continue as projects come on-stream over the next five years. Still to be finalised are the detailed development plans for the three biggest oil discoveries since Barrow Island, namely Cossack, Wanaea and Griffin, while important discoveries continue to be made, with Wandoo being the latest. Overall, Western Australia is set to become the leading producer in Australia by the mid-1990s, as Bass Strait reserves decline.

The spectacular exploration success rate in the northern Carnarvon Basin since 1989 has attracted a large proportion of Australian petroleum exploration. For 1991, the Australian Petroleum Exploration Association has forecast a probable exploration expenditure (seismic and drilling) of $227 million or 44% of the Australian total and $998 million for development drilling or 89% of the Australian total. Only two years ago Western Australia's petroleum exploration expenditure bottomed out and was below that of each of the Northern Territory, Victoria, Queensland and South Australia.

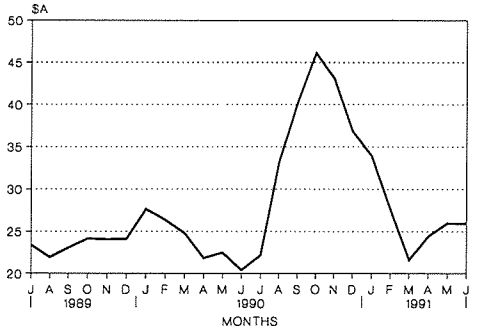
In 1990-91 a total of 31 exploration wells

PETROLEUM PRODUCTION
(including CONDENSATE)

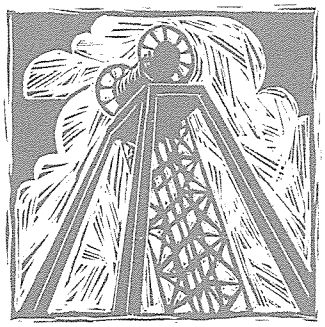


SOURCES:DEPT OF MINES WESTERN AUSTRALIA
BMR & ABARE

CRUDE OIL PRICES: $A/bbl



SOURCE: BRENT SPOT, MONTHLY AVERAGE.



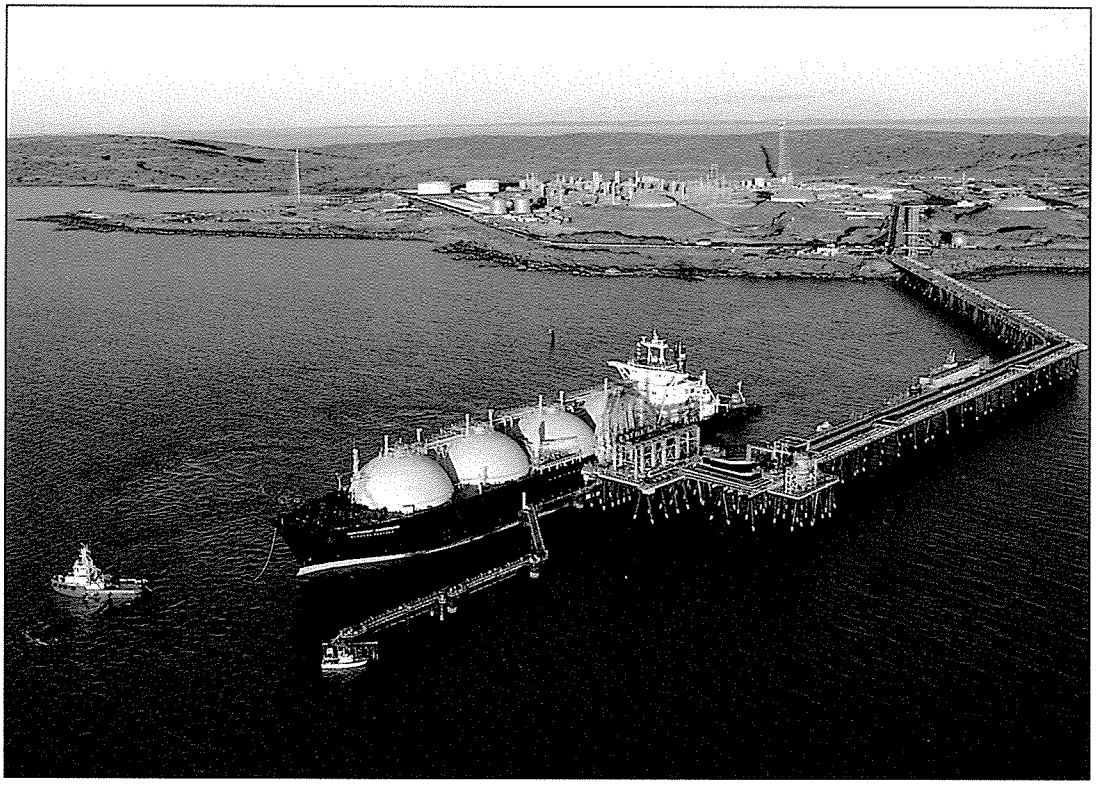
were drilled with 19 in the Carnarvon Basin. The others were split between onshore north Perth Basin (6) and Canning Basin (4), with one each in the Browse and Bonaparte Basins. Successes were mainly restricted to the Carnarvon Basin at *Yodel* (gas/condensate), *Scindian* (gas over oil) and *Ramillies, Leatherback* and *Wandoo* (oil). Wandoo was significant producing a relatively heavy crude oil from a new trend at relatively shallow depth (600 metres). A small oil discovery was recorded at *Boundary*, near Blina, in the Canning Basin and a small gas discovery made at *Ocean Hill* in the Perth Basin.

While exploration drilling was slightly below that of the previous year, the number of development wells was increased substantially to 43 (13 in 1989-90). Apart from two development wells in the Perth Basin, all were in the Carnarvon Basin.

Seismic survey activity involved a large proportion of 3-D surveys and also a significant amount of non-exclusive speculative surveying. The Carnarvon Basin, with nearly 31 000 line km out of a total of 41 500 line km, was again the focus of work. Of special interest, however, was a speculative survey in the offshore largely unexplored Eucla Basin. This acreage will be advertised for release by the Commonwealth in late 1991. Under a new policy, all vacant acreage landward of the baseline is available for application on a quarterly basis. This replaces the predetermined-block release system. In 1990-91 there were 16 new permits granted, divided equally between onshore and offshore. Overall 96 exploration permits were in force at 30 June 1991 covering about one-fifth of the total area of sedimentary basins in the State.

Carnarvon Basin

Woodside and its joint venture partners dominate the petroleum sector with domestic gas, condensate and LNG sales totalling $1 562 million. The year commenced with a



Increased shipments of LNG from Woodside's North West Shelf operation helped petroleum become WA's fourth $2 billion industry, together with iron ore, gold and alumina.

total production system shutdown to change the flare tip on the *North Rankin* platform. Advantage was taken of the shutdown to carry out other maintenance and project work, including the installation of the isolating valves for the subsequent Goodwyn link-up. Other remedial work was undertaken during the year on the platform-to-shore trunkline. This did not affect production. LNG production was stepped up as a fourth specially developed tanker was brought into service. In June a milestone was reached with the one hundredth LNG cargo being loaded. LNG shipments will increase after a third train is constructed.

Progress continues to be made with fabrication of the *Goodwyn* A platform. Offshore installation is scheduled to commence in November 1992, with production planned from the September quarter of 1993.

The joint venture also holds title to gas/condensate accumulations at *Echo, Yodel* (discovered October 1990), *Angel* and *North Rankin West*. A successful appraisal well significantly increased the recoverable reserves at Angel to 42.1 x 10^9 m^3 of gas and 12.5 x 10^6 kL of condensate. NRA-22, drilled from the North Rankin platform, increased reserves in the North Rankin West fault block.

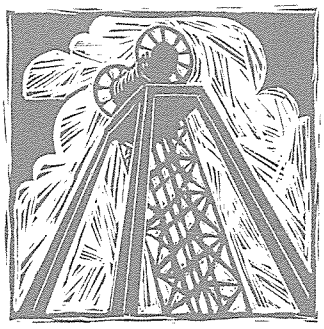
East of the Rankin Trend, Woodside is reviewing development options for the importnat Wanaea and Cossack oil fields. Wanaea, discovered in 1989, has estimated reserves of 23.1 x 10^6kL. Cossack, discovered a year later, is slightly smaller with 13.2 x 10^6kL of estimated recoverable oil. A feasibility study has been completed for Cossack, with a proposal to utilise a floating production storage and offloading facility (FPSO), and subsea wellheads. Under the development proposal, tenders are due to be let from mid-1991 to the end of 1992 to allow production to commence in mid-1993. For Wanaea, screening studies were completed in the September quarter, and a feasibility study to assess possible development concepts is planned to be completed by mid-1992. Production is expected from Wanaea before the mid-1990s.

Marathon Petroleum Australia Ltd's *Talisman* field, the only oil producer on the Legendre Trend, produces from an FPSO with moored tanker. In 1990-91 production was 331 000 kL of oil.

WAPET's Saladin field was the source of approximately half the Sate's oil production this year. The field commenced in 1989 and, overall, has produced 4.0 x 10^6 kL. The 1990-91 production of 2.6 x 10^6 kL was handled by facilities on Thevenard Island. Re-mapping has allowed a reappraisal of the reserves; almost doubling original estimates. Remaining reserves now stand at 3.224 x 10^6 kL. Output was supplemented late in the year when *Yammaderry* (March 1991) and *Cowle* (April 1991) began producing via unmanned monopod platforms. *Roller*, a 1990 discovery, was subjected to 3-D surveys to plan further drilling and finalize development plans.

The *Harriet* field was the State's second largest oil producer with 828 000 kL. Following the signing of gas sales contracts with SECWA in December 1990, work commenced on a $120 million gas gathering project. In addition to gas being recovered from Harriet and Rosette, two new offshore platforms are being constructed for the Sinbad and Campbell gas fields, to the north of Harriet. Gas separation will take place adjacent to the existing handling facility on Varanus Island then be transported 100 km by pipeline to the SECWA No. 1 compressor station on the Burrup Peninsula. Gas production is due to commence in June 1992 at 30 TJ per day, building to 40 TJ and eventually 200 TJ per day.

The *Barrow Island* field, the long-time mainstay of oil production in the State produced 773 000 kL in 1990-91. The Windalia pilot infill drilling program was almost completed and WAPET's efforts will be



concentrated on the workover program. Over the next twelve months a study will be carried out to assess all reservoirs and plan a long term depletion program.

Western Mining Corporation's oil production continued from the small fields of *South Pepper, North Herald* and *Chervil*. Combined output of 516 000 kL was shipped from the Airlie Island facility and remaining recoverable reserves are estimated at 940 000 kL. Development drilling has extended the known eastern limits of the Chervil field. Gas lift equipment is being installed at both Chervil and South Pepper.

Following the *Chinook* and *Griffin* discoveries in 1989-90, BHP Petroleum continued to drill successful extension test wells and make further discoveries in 1990-91 in the area to the south-west of Barrow Island and west of Saladin. The discovery of *Ramillies*, a separate accumulation on the Griffin structure, was followed by a more substantial oil and gas discovery at *Scindian* in early October. Total oil reserves from these fields are estimated at 16.7×10^6 kL, of which 13.0×10^6 kL are contained within the Griffin field. This makes it comparable in size to Woodside's Cossack field. Plans for development are proceeding.

Other discoveries in the basin during the year include *Wandoo*, discussed above, and Leatherback. *Leatherback*, an oil discovery by Lasmo Oil Co Australia Ltd, is located just to the north of Exmouth Gulf. It was discovered in late June and the economics are yet to be defined.

The *Tubridgi* gas field, onshore to the south-west of Onslow, is preparing for commissioning by October 1991. The major gas transport pipeline and gas collecting flowlines have been installed. Site works for the gas processing plant are completed, with installation of process equipment ongoing. Production will come from six wells, with gas supplied to SECWA at a contract rate of 15 TJ per day.

Canning Basin

After considerable interest being shown in exploration in the Canning Basin in the mid-to late-1980s, the level of activity is now low due to discoveries being limited and small as well as the oil price being low. During 1990-91 two exploration wells were drilled, with a small oil pool discovered at *Boundary*, near Blina. Two extension test wells were unsuccessful and only a relatively small amount of seismic surveying (320 line km) undertaken.

Production by Petroleum Securities Energy Ltd continued at *Blina* and *Sundown/West Terrace/Lloyd/Boundary* at a combined output of 18 000 kL for the year. A small test production from West Kora was also recorded during the year.

North Perth Basin

WAPET's longstanding producing fields of *Dongara and Mondarra* contributed 108×10^9 m^3 of gas and 5 700 kL oil and condensate for the year. The company is in the process of performing a depletion study, with pressure build-up and static pressure surveys carried out in May. The work will assist in the development of a workover and recompletion program for 1992.

The other production in the basin came from Consolidated Gas's *Woodada* (102×10^9 m^3 gas) and Arrow's *Mt Horner* (32 600 kL oil) fields.

Extended production testing was carried out on the 1990 gas discovery at *Beharra Springs*. The test was shut down in February 1991 due to higher than expected H_2S levels in the gas. Scavenger chemicals are to be utilised in new extended production tests to be commenced in early July. A contract has been awarded for the design of permanent processing facilities to the WANG pipeline gas specification for transfer of gas to Alcoa's Pinjarra alumina refinery. The project was taken over by Sagasco Resources

Ltd from Arrow Petroleum (formerly Barrack) in June 1991. Commercial production is scheduled for January 1992.

The onshore part of the Basin was relatively active in exploration with one successful extension test at Beharra Springs and five wildcat exploration wells, one of which recorded a small gas discovery at *Ocean Hill*. Seismic work was more active offshore (1 502 line km) and two offshore permits were issued in an area which has seen little exploration.

Other Basins

A total of 3 900 line km of seismic survey was shot in the Bonaparte and Browse Basins. Two unsuccessful exploration wells were drilled.

In the Eucla Basin 5 496 line km of speculative seismic was shot offshore by Japan National Oil Corporation. The area will be advertised for release in late 1991.

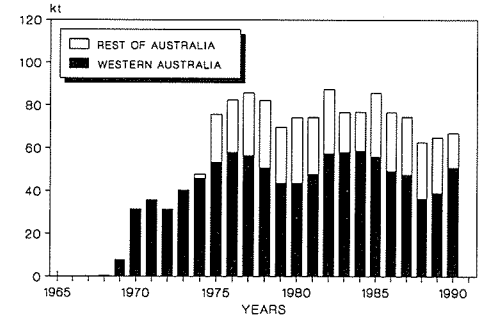
NICKEL

There was a much greater degree of stability in the nickel price through 1990-91 than for a number of years. Except for a peak in August-September, as a result of a strike in New Caledonia and maintenance shutdown in the Dominican Republic, the general price level has remained in a narrow band just below $US 4.00 per lb. Analysts have predicted an improvement in prices in 1992. There is general optimism in the longer term with relatively strong demand predicted to grow at 2.5% per annum. INCO, the world's largest producer, which has been somewhat conservative in its plans throughout the late-1980s, is now committed to a five-year expansion program, but based on lower cost, higher grade mine developments, Western Mining Corporation (WMC) is also striving to regain its cost competitive position in the market place and has major expansions planned if cost cutting can be achieved. The multitude of projects in Western Australia, being re-evaluated during the price boom of 1988 and early-1989 are being sorted out with the more viable ones advancing slowly towards development.

Nickel mine production in Western Australia increased by 13% over the previous year to record 54 000 tonnes of contained nickel in concentrates. This was converted to 18 000 t of matte at the Kalgoorlie Nickel Smelter and from this, part was processed at the Kwinana refinery to produce 26 000 t of nickel metal products. In value terms, nickel plus by-products were only marginally improved on last year's figure, at $602 million (up 1%).

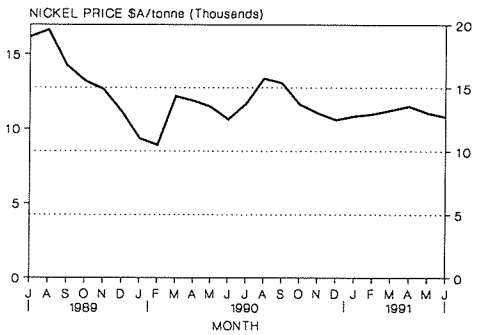
At this stage, WMC continues to be the only operator in the State, with production centres at Kambalda, Leinster and Windarra. At *Kambalda* there has been a progressive move to gain underground access by decline, rather than the traditional shaft operations. The operations at

NICKEL PRODUCTION

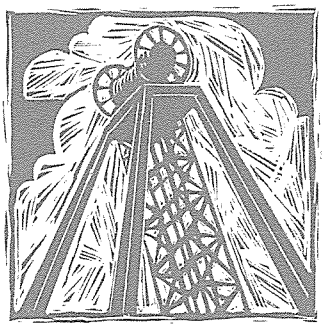


SOURCES:DEPT OF MINES WESTERN AUSTRALIA, BMR & ABARE

NICKEL PRICE



SOURCE: L.M.E Average Spot Price.



Foster, Lanfranchi, Otter, Mt Edwards and Wannaway typify this; the new Mariners orebody development, under Lake Zot, is being accessed by a decline from an island within the lake. One of the stalwarts of production at Kambalda, Long Shaft, produced its three millionth tonne of ore in June 1991; about the halfway point of its mine life.

The *Leinster* operations produced from the Perseverence and Rocky's Reward open cuts and a decline from Rocky's Reward pit. Development work continued towards reopening of the main Agnew (Perseverance) underground mine. Leinster was the main centre to pick up the expanded production by WMC and replace output from the depleted operations at Windarra. The current Leinster concentrator has a capacity to treat 1 Mtpa of ore to produce about 15 000 tpa of contained nickel in concentrate. In addition, Leinster ore was transported for treatment at the Windarra plant. In total Leinster produced 18 500 t of contained nickel in concentrate during 1990-91.

The *South Windarra* open cut closed during the year but the process plant continued operations on Leinster ore and gold ore from Lancefield and Beasley Creek.

WMC has an investment program of $300 million planned to increase contained nickel production to 65 000 tpa. This plan is contingent on satisfactory resolution of a number of issues aimed at reducing its costs in line with its major competitors. A cost reduction of 30% is considered necessary. This can be achieved by change in work practices (seven day operations), a renegotiation of energy costs (mainly at the refinery), and a reduction in freight charges between Leinster and Kalgoorlie. To achieve the expansion plan the Leinster concentrator will be doubled in size and Kambalda will produce an additional 5 000 tpa of contained nickel.

Having almost committed to development of the large, low-grade *Mt Keith* deposit late in 1990, the joint venture of Australian Consolidated Minerals Ltd (ACM) and Outokumpu Oy of Finland put plans on hold while high magnesia levels in the concentrate product were further investigated. Further metallurgical testwork solved that problem and the partners agreed to review the feasibility study costs, with a view to committing to development at an early stage. A new deal is planned whereby Outokumpu receives 50% in the project at a cost of $80 million. The issue has been complicated by stock market takeover bids for ACM.

Also in the Northeastern Goldfields another major development is being promoted by Dominion Mining Ltd at *Yakabindie-Six Mile*. This is located to the south of Mt Keith and is of similar grade ore and with slightly smaller production rate (22 000 tpa contained nickel). An exploration shaft has been completed to collect a bulk sample for metallurgical testing, while feasibility study work progresses. The project has received significant publicity on Aboriginal sacred site issues.

Construction work is in the final stages for the small $37 million, nickel-copper matte project at *Radio Hill*, 30 km south of Karratha. A 7-year, 150 000 tpa underground development is planned, with onsite smelting, using ISASMELT technology. Startup is scheduled for the December quarter 1991.

Other small developments being considered are at Spargoville, near Kambalda, and Carr Boyd Rocks, north of Kalgoorlie. Preliminary feasibility studies are being undertaken by WMC and Resolute Resources on the Bulong laterites; while Outokumpu has assumed full control of the Forrestania deposits, after exercising its pre-emptive right to Arimco's 50% share.

BASE METALS

Over the last few years, exploration for base metals, including nickel, has picked up part of

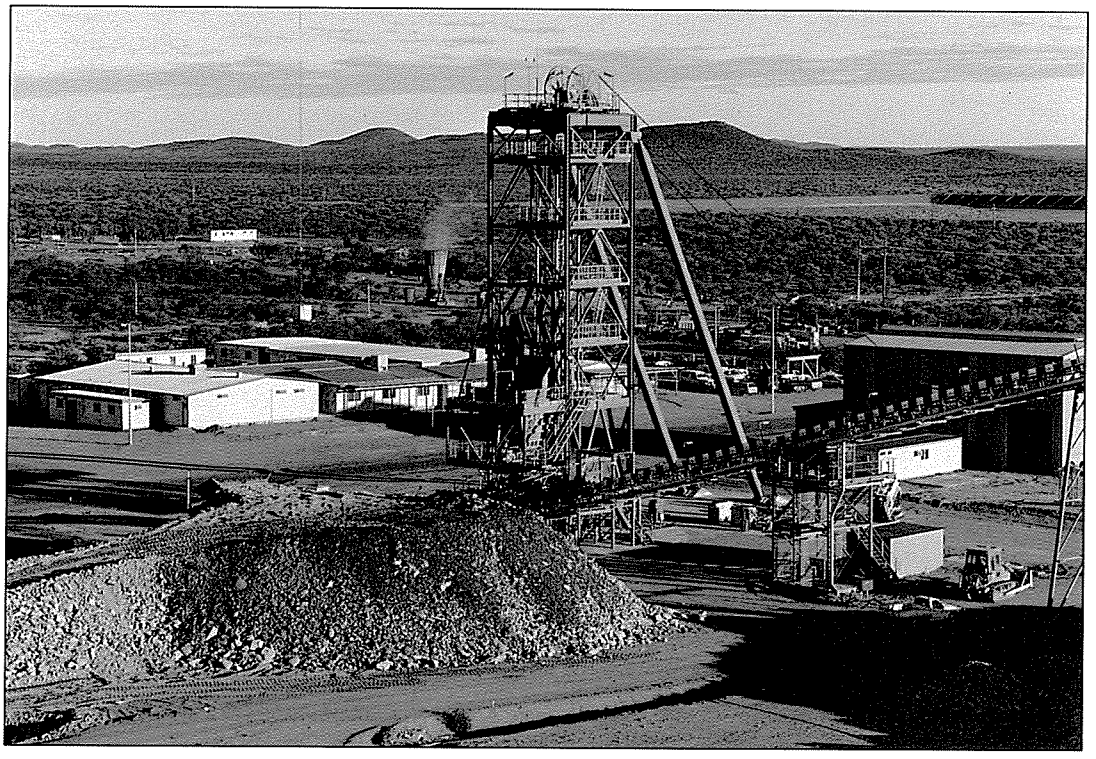
the declining gold exploration expenditure in Western Australia. Expenditure is expected to have been $46 million in 1990-91, an increase of 25% over the previous year. Work is spread throughout the State covering prospects in the Halls Creek area, Canning Basin, Pilbara, East Pilbara - Rudall area, and to a lesser extent the Yilgarn.

However it is a prospect, discovered in 1979, which was the most significant feature in this sector in 1990-91. The *Scuddles* underground mine and concentrator of the *Golden Grove* project commenced production in August 1990, with first shipments from the port of Geraldton in late-November. After a number of technical and operating teething problems, the project was approaching operating levels at design capacity by year end (800 000 tpa of ore). Design is for an output of 180 000 tpa of zinc concentrates and 20 000 pa copper concentrates. Production for the year was about 145 000 tonnes of zinc concentrates and 20 000 tonnes of copper concentrates.

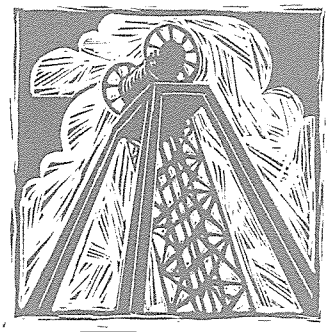
With a 13 year design life at Scuddles and substantial resources of predominantly copper ore at nearby Gossan Hill the project can look to a long-term future. In fact recent drilling has enhanced a smaller zinc-rich zone at Gossan Hill, while a significant high-grade gold resource has been identified in the oxide zone, to 70 metres depth. Scoping studies are being undertaken for an accelerated gold, copper, zinc development at Gossan Hill.

A significant innovative feature of the Golden Grove development is the recruitment and training program initiated by the company of a workforce of people new to the mining industry. A four-year course is being conducted on all aspects of mining for the new mine workers.

The *Cadjebut* zinc-lead mine, in the Fitzroy Crossing area, exceeded its expanded design capacity to treat 536 000 tpa of ore during the year for a production of 117 000 tonnes of zinc concentrate and 18 000 tonnes of lead concentrate.



Western Australia's most significant base metal mining operation, the Golden Grove mine, 230km east of Geraldton, produced 145 000 tonnes of zinc concentrate and 20 000 tonnes of copper concentrate during the year.



Other copper production during the year was sourced from gold operations at *Telfer* and *Horseshoe Lights*, although the treatment of stockpiled ore at Horseshoe Lights had ceased by the end of 1990. The copper flotation circuit at the *Boddington* gold mine was almost completed and ready to start production by year-end.

Of the undeveloped prospects, resources of 4 million tonnes at 3% Cu (oxide zone) and 17 Mt at 4.9% Cu (primary zone) have been announced at WMC's *Nifty* prospect to the east of the Pilbara. Development plans may be announced towards the end of 1991. Dominion Mining Ltd are evaluating the feasibility of undertaking heap leach operations on its wholly-owned *Whim Creek, Mons Cupri* and *Whundo* copper deposits in the West Pilbara.

Of the exploration prospects, CRA has announced inferred resources at its long term, *Admiral Bay* prospect in the central Canning Basin. An upper horizon is estimated to contain 120 million tonnes at 2.3% lead, 6.4% zinc and 32 grams per tonne silver and a lower horizon has 20 Mt at 16.9% lead, 0.4% zinc and 57 g/t silver. This mineralization lies at 1 250 to 1 550 metres depth. Significant exploration activity is being undertaken at *Koongie Park*, near Halls Creek, and seven gossan targets are being explored at *Panorama*, 120 km south-east of Port Hedland, where a number of intersections of high-grade combinations of copper, zinc, lead and silver have been announced. The work is too early for resource estimates.

Despite the fall in copper, zinc and lead prices the new developments and advanced stage prospects are seeing this sector grow in importance in the State, which previously has not been a major base metal producer.

DIAMOND

After three years of phenomenal growth the diamond market plateaued in 1990. The general economic downturn and political uncertainties around the world have resulted in the Central Selling Organisation (CSO) announcing 16% lower sales in the first half of 1991. However by restricting supply the CSO managed to stabilize the market and achieved a small price increase.

Western Australia's diamond sales were 32.3 million carats, down 5% on the previous year, but improved prices saw revenue increase by 14% to $471 million.

To counter lower concentrations at depth in the AKI pipe at *Argyle*, ore throughput has progressively been increased to currently stand at a 6 Mtpa capacity, with plans to increase it to 8 Mtpa in 1992. Production will thus be maintained at 30 - 35 M cts pa. A major reevaluation of the exploitable reserves in the AKI pipe has almost doubled the previous estimates. A total of 100 Mt at nearly 4 cts/t remained at the end of 1990, compared to 58 Mt @ 6 cts/t previously and 61 Mt at start up of operations in 1985. This will allow a further 15 years of operation at expanded ore production levels. A further resource of 260 Mt @ 3.6 cts/t has been estimated to occur at depth. Argyle will produce its 200 millionth carat in 1991.

With the initial sales contract with CSO nearing completion, Argyle Diamond Sales has negotiated a further five year contract, which includes the 5% share of production held by the West Australian Diamond Trust.

Poseidon's *Bow River* operation experienced a depressed market for both gem and industrial categories. Upgrade of resource estimates doubled the figure to 14.5 Mt, allowing the higher production level of between 2 and 3 Mtpa to be sustained in the longer term. At the company's *Mt Elizabeth* joint venture, on-site plant testing was completed in November 1990 having treated 100 000 tonnes of material from the Aries pipe.

Elsewhere exploration continues at a relatively high level, with $29 million estimated to have been expended in 1990-91 (up 15% over the previous year). Diamond and indicator

minerals have been reported from various localities, but no significant discoveries announced. The increasingly difficult access to Aboriginal reserves and other restricted areas are seen to be particularly significant to diamond exploration, especially in the Kimberley region. This could result in a contraction of effort in the future.

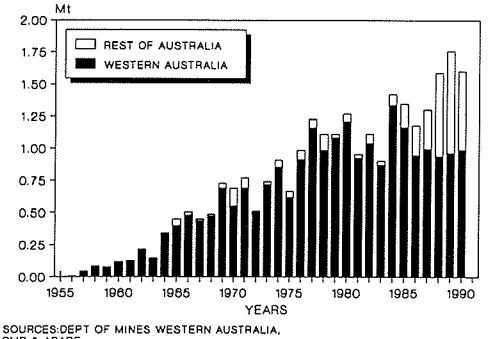
HEAVY MINERAL SANDS

After five years of sustained growth and substantial development activity there was a significant decline in demand for almost all mineral sands products resulting in cuts in shipment levels by the Western Australian producers. Monazite and zircon were more severely affected than the titanium minerals, with 50% and 30% reductions in sales respectively. Ilmenite prices tended to maintain their high levels, but all other products showed declining prices although still at acceptable levels. Overall the value of shipments was reduced by 18% to $389 million for the year.

While the general effects of the world economic downturn will continue to affect the sector overall, there were signs in the June quarter of a stabilising level of shipments and the longer term outlook remains reasonably promising.

The large new fully integrated operation of the *Tiwest Joint Venture* continued its progress to bring its process streams on-line with the commissioning of the Muchea synthetic rutile plant in November 1990 and near completion of the Kwinana titanium dioxide pigment plant by year-end. Mechanical problems were experienced with the dredge at Cooljarloo in the early part of the year.

ILMENITE PRODUCTION



SOURCES:DEPT OF MINES WESTERN AUSTRALIA, BMR & ABARE

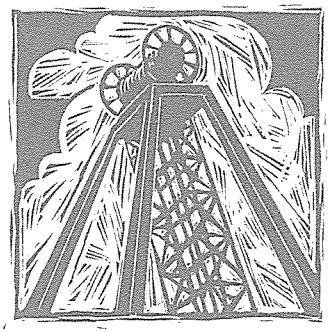
Associated Minerals Consolidated Ltd (AMC) completed refurbishment of its dry processing plants at *Narngulu* and *Eneabba* to incorporate modern dust containment equipment. The Narngulu plant was also extended to handle the feed from the new *Eneabba West* mine which was commissioned in February 1991. At the same time as this operation commenced, the company announced the suspension of operations for one year at the zircon-rich mine of *Eneabba North* on account of slackening demand, increasing stockpiles and lower prices.

Similarly the upgrading of the existing synthetic rutile plant and completion of a new 130 000 tonne second line in April 1991 was accompanied by an announcement that one line would remain shut down for at least six months.

AMC's operation at *Capel South* was supplemented by the acquisition of Simto Resources' properties in the area. At the time Simto was at the stage of developing a deposit at Wonnerup, adjacent to AMC's mining path.

Westralian Sands Ltd also ceased production until further notice at its Yoganup Extended mine site due to weak demand. Production continues at *Yoganup North* and *North Capel*. The company is also evaluating the possibility of putting in a second synthetic rutile line at Capel.

The long delays experienced by Cable Sands in finalising approvals for its *Jangardup* project continue, resulting also in the Bunbury dry processing plant extension being deferred. The outstanding issue involves final details of the transport proposal between the South Coast and Bunbury. This matter has been further



complicated by delays to a decision by Mineral Deposits Ltd on its *Beenup* project development which was to have shared the cost of the Sues Road transportation option with Cable Sands. Beenup has ostensibly been delayed for at least a year while alternative power transmission line route options to the minesite are considered in view of opposition to the Manjimup line initially selected. In the meantime trial pit and pumping tests are to be carried out at Beenup.

Cable Sands completed mining its *Minninup Beach* site in July 1990 and has subsequently completed rehabilitation there, with this work becoming a showpiece for the achievements in rehabilitation of the modern industry. The dredge was moved to *Busselton East*. The company currently produces from *Busselton East* and *Waroona South*.

The terms for exploration activity in the D'Entrecasteaux region by Cable Sands are being finalised following the new National Parks policy announced by Government in November 1990.

The downturn in the heavy mineral sands industry has affected grass roots exploration activity, with most companies in the Eucla Basin search currently seeking joint venture partners.

The newest producer in the State, ISK Minerals Pty Ltd, with its operation at *Waroona South* and plant at *Picton*, is very active in picking up relinquished tenure and acquiring properties in the Perth Basin to sustain its medium and long-term operations. As its Waroona South operation becomes depleted, Dardanup, a property acquired from Metana Minerals, is the next possible development.

SALT

With an annual revenue of about $140 million and providing 30% of the world's traded salt, the Western Australian salt industry has taken advantage of the strong

During the year, WA provided 30% of the world's traded salt, part of it from Leslie Salt's operations near Port Hedland.

demand and price over the past few years. Production increased to 6.7 million tonnes (up 13%) in 1990-91, with all operators producing at near capacity levels.

Leslie Salt at *Port Hedland* has planned to increase its production from 2 million tonnes per year to 2.25 million tonnes per year next year, and, through process changes (as opposed to increased area under cultivation), the *Dampier* operation is expanding from 2.5 to 4 million tonnes per year. On Dampier Salt's other operation at *Lake MacLeod* a drilling program to confirm the availability and suitability of an alternative brine aquifer was carried out. Gulf Holdings at *Onslow* is progressing with approvals to develop a 1.5 million tonnes per year, $80 million project by late-1992.

With the number of new developments and expansions around the world as a result of the buoyant market, a more difficult market is being predicted with a possible oversupply by 1992-93. The large and lucrative markets of Japan, Taiwan and Korea, which take about 70% of the State's exports, is being targeted by a number of competitors, already providing a tougher market.

COAL

Coal production from the two *Collie* producers rose almost 1 million tonnes (23%) to 5.13 million tonnes valued at $230 million in 1990-91. In February 1991 the 100 millionth tonne of coal was extracted from the Collie coalfield since commercial production commenced in 1898.

The Collie area received a tremendous boost with the Government announcement on 1 May 1991 that it had selected a privately-owned and operated coal-fired power station at Collie as the next base load power supply. This decision was concluded after intense negotiations in which the coal companies, miners and SECWA unions had to accept cost cutting measures to slash $300 million off SECWA coal bills over the next 12 years. As a result of the decision, coal production is expected to stabilise at around 5.4 million tonnes per annum for 4 years, before increasing to 7-8 million tonnes per year as the power station is scheduled to come into production in 1996-97.

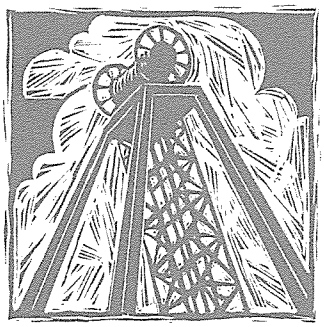
The rejection of the *Hill River* coal development and power station by SECWA and subsequent backing of the declaration of the Mt Lesueur National Park by Government, including a substantial part of the coal deposits, has effectively sterilised this potential source of coal for the future.

OTHER MINERALS

The improved demand and successful marketing undertaken by the State's two *tantalite* producers, *Greenbushes* and the Panwest Joint Venture at *Wodgina*, resulted in a doubling of sales for the year to 273 000 kg of contained tantalum in concentrates, valued at $28 million. Greenbushes has been particularly successful in securing a five year sales contract for tantalite concentrates worth about $120 million, giving stability to price and supply over an extended period to a commodity which has seen tremendous fluctuations in the past.

A full reappraisal of the Greenbushes operation has now been completed by Gwalia Consolidated Ltd resulting in a 15-year plan being formulated, centred around the exploitation of hardrock tantalite and spodumene resources by two deep open cuts, as opposed to the originally conceived underground developments. A $40 - 50 million investment is envisaged over the next five years, which includes progressive process plant rationalisation and expansion.

Having seen metallurgical grade *manganese ore* prices rise from around $US1.45/tonne unit in 1988 to over $US3.50 by the end of 1989, a small dumps retreatment operation was commenced at the old *Woodie Woodie* mining



centre in the East Pilbara. This was shortly followed by a Portman Mining/Hancock Mining Joint Venture to produce trial shipments from small bedrock resources at Woodie Woodie. The first shipment was in September 1990. Such was the success in tying up sales contracts with South Korea, Japan, China and Taiwan that prices continued to rise to around $US4/tonne unit and a commercial operation was quickly established, with production reaching a level of about 250,000tpa of high grade (44-48% Mn) ore.

Rising *vanadium* prices produced new interest in a number of the State's deposits of vanadium-bearing titaniferous magnetite. The most advanced project is at *Wagoo Hills*, in the Windimurra Complex, 70 km east of Mount Magnet, where Precious Metals Australia Ltd is carrying out metallurgical testing on a resource inferred at 10 Mt averaging 0.55% vanadium pentoxide. The company proposes to use coal from Irwin River to process the ore.

The long-awaited *uranium* debate at the Labor Party Conference did not eventuate and the three-mine policy remains. While uranium exploration was expected to be nearly $8 million in 1990-91, it could be that there will be a substantial decline in exploration for a commodity which, under current policies, has little chance of development.

The commencement of *silicon metal* production at Kemerton in January 1990 turned into a disastrous exercise as market prices plummeted and have not recovered since. The $120 million development by Barrack Silicon (SIMCOA) has recently been sold to the banking syndicate creditors of the Barrack Group.

There are a number of other industrial mineral producers in the State supplying both export and domestic markets. Most notable export commodities are talc, spodumene, silica sand, attapulgite and garnet. In total the value of production of all of these commodities amounted to nearly $50 million in 199091.

In addition there are a number of other projects being evaluated and promoted. These include a study to investigate commercial development of a high grade *rare earth* deposit at *Mt Weld*, 35 km south-east of Laverton; a commitment in principle to a $12 million development of high carbon flake *graphite* at *Munglinup*, near the south coast east of Ravensthorpe; a feasibility study to produce 98% acid grade *fluorite* concentrate at *Speewah* in the East Kimberley and a potential high purity *kaolin* development near *Mullewa*, east of Geraldton. Enquiries from overseas customers for various *dimension stone* supplies continues at a high rate.

THE MINING AND PETROLEUM INDUSTRY

THE YEAR IN REVIEW

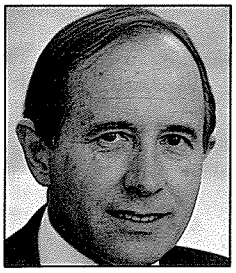
Another giant scoop of coal, bringing to 100 million tonnes, the quantity of coal mined from the Collie coalfields since 1898.

The Kalgoorlie Terrane

" ... the challenge of the future for exploration geologists will be to find new orebodies in areas that are completely covered by soil and other superficial deposits."

It was not long after the discovery of gold at Coolgardie and Kalgoorlie, in 1892 and 1893, that the Geological Survey of Western Australia commenced geological mapping in the Eastern Goldfields.

A geological map of the Coolgardie Goldfields was published in 1898 and a comprehensive map of the Kalgoorlie Goldfield in 1903. Since that time the Geological Survey has published numerous geological maps of individual mining areas and a number of broad regional maps in this area.



Dr P E (Phil) Playford, BSc (Hons), PhD
Director, Geological Survey of WA

In 1979 the Geological Survey opened a regional office in Kalgoorlie, and began systematic geological mapping of the whole of the Eastern Goldfields at 1:100 000 scale, with assistance over the past three years coming from the Commonwealth Bureau of Mineral Resources under the National Geoscience Mapping Branch.

Recent detailed geological mapping has revealed that the rocks containing major deposits of gold and nickel are part of a distinct geological unit called the "Kalgoorlie Terrane", and a map of this unit in two sheets was published by the Geological Survey in 1990. It was presented to an international conference of geologists held in Perth during September of that year.

The Director of the Geological Survey, Dr Phil Playford, said recognition that the Kalgoorlie Terrane was distinct from adjacent superficially similar sequences of rocks is of fundamental importance in understanding the geological history and structure of the Eastern Goldfields, and would greatly assist mineral exploration.

"The map has received widespread acclaim among geologists exploring the area, and it reflects great credit on the team of geologists involved," he said.

The Kalgoorlie Terrane, covering an area of about 15 000 square kilometres, is of major economic importance to Western Australia, as it includes both the Golden Mile and Kambalda, which have produced 1 625 tonnes of gold and about 800 000 tonnes of nickel, representing 60% of the gold and 78% of the nickel produced in the State to date. At today's prices the total worth would be $34.5 billion (gold $25 billion, nickel $9.5 billion).

The Kalgoorlie Terrane consists of volcanic and sedimentary rocks that formed about 2700 million years ago, perhaps in a situation similar to that now existing in parts of the Indonesian archipelago. The nickel deposits found at Kambalda formed during the volcanic eruptions as they poured out on the Earth's surface, to form discrete lenses within the volcanic rocks.

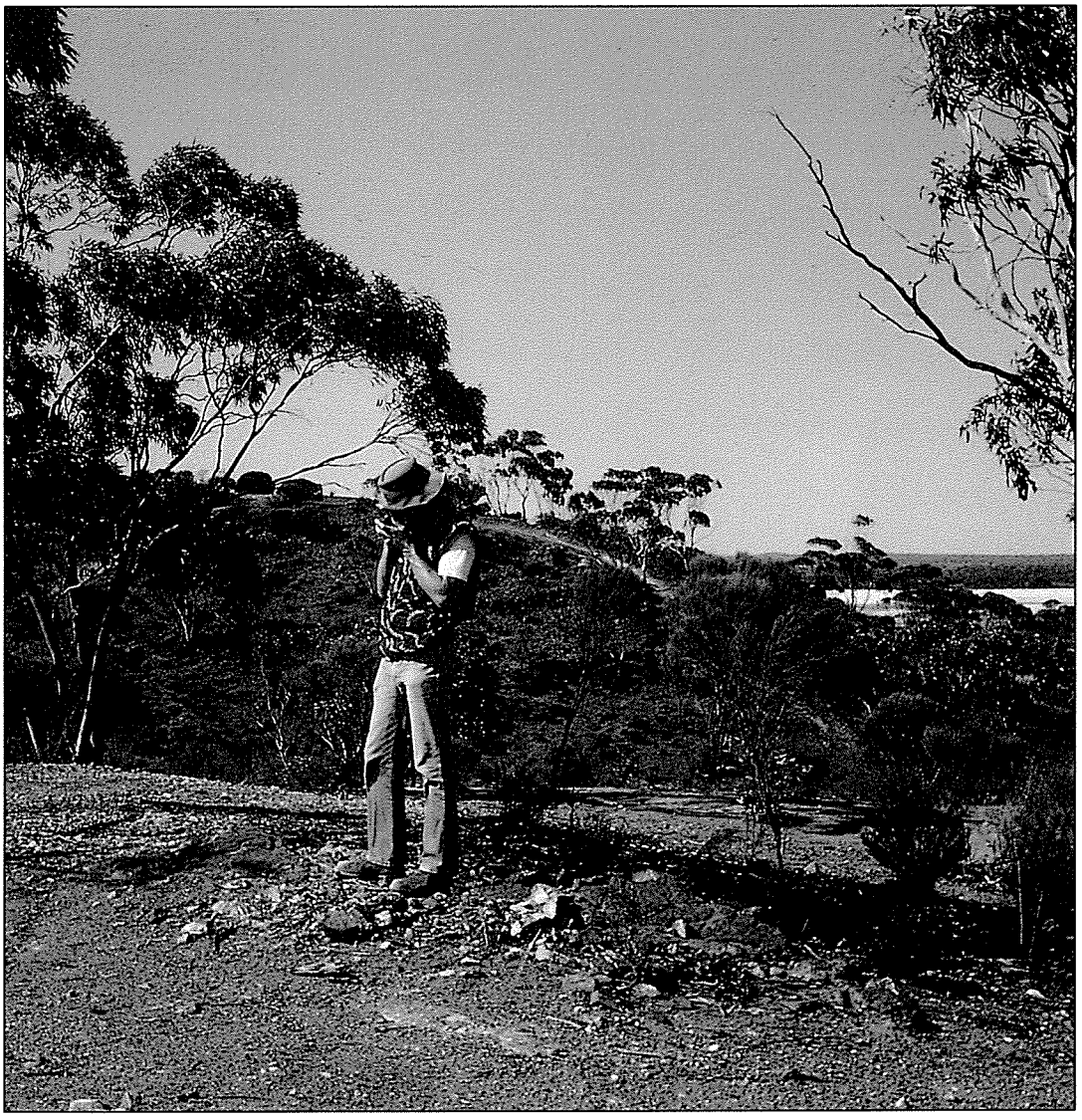
These volcanic rocks were subsequently deformed and fractured by intense heat and pressure below the Earth's crust, and their mineral composition was altered. They were also intruded by granite which locally caused further heating and alteration. This deformation and alteration was accompanied by gold mineralization along particular zones, when hot fluids were being squeezed through the rocks.

These fluids also altered the composition of the rocks they passed through and the recognition of these altered zones can be expected to lead to the discovery of further gold deposits in this highly prospective Terrane.

The mapping program currently being carried out by the Geological Survey and the Bureau of Mineral Resources will provide information necessary to define other terranes within the Eastern Goldfields between Wiluna and Norseman. Each terrane will have slightly different geological characteristics which may influence the type and style of mineralization to be found in it. The recognition of these characteristics and their influence on mineralization will greatly assist the exploration for new orebodies in each terrane.

Dr Playford indicated that the challenge of the future for exploration geologists will be to find new orebodies in areas that are completely covered by soil and other superficial deposits.

"The geological concepts embodied in the new Kalgoorlie Terrane map will be of fundamental importance in the discovery of such obscured orebodies in the Eastern Goldfields," Dr Playford said.



Officer-in-Charge of the Geological Survey's regional office in Kalgoorlie, Dr Wally Witt, examines a rock sample near Hannan's Lake, south of Kalgoorlie.

GEOLOGICAL SURVEY DIVISION

THE YEAR IN REVIEW

INTRODUCTION

The past year has been a productive and stable period for the Geological Survey Division with a comprehensive work program undertaken, most of which was completed on time.

A notable milestone during 1990 was the publication of Memoir 3. The production of this volume has occupied a very large amount of staff time and expense since 1985. Memoir 3 is a volume that the Division can be proud of. There were also many other important publications released during the year, including the Murchison Bulletin and maps of the Archaean Kalgoorlie Terrane.

The National Geoscience Mapping Accord began operating in Western Australia with joint mapping programs involving the Bureau of Mineral Resources (BMR) in the Eastern Goldfields, East Kimberleys, and Canning Basin. The Geological Survey is also mapping in the Pilbara-Paterson area, while the BMR is mapping independently in the Musgrave Block. The latter Accord project will continue into South Australia and the Northern Territory, but the Geological Survey does not intend contributing directly to this work.

The Geological Survey Division has been spared the traumatic reorganisations and other upheavals that have adversely affected many other Geological Surveys in Australia. This is in large measure due to the support received from industry in this State and to the Division's response to industry needs as expressed through the Geological Survey Liaison Committee, set up in 1986. It is of the utmost importance to the future of the organisation

Pictured at the launch of the publication "Memoir 3" are (from left) the Director of the Geological Survey Dr Phil Playford, the General Secretary of the Chamber of Mines and Energy Mr Pat Gilroy, the Director General of Mines Dr Des Kelly and a representative of the Association of Mining and Exploration Companies Mr Geoff Blackburn.

that industry support be retained, and indeed strengthened.

A Government decision made during the period of review that will be of considerable importance to the future of geoscientific research is to provide funding for the Geological Survey Division to join a consortium with Curtin University of Technology and the University of Western Australia to purchase a Sensitive High Resolution Mass Spectrometer (SHRIMP). The machine will allow very precise radiometric dating of rocks and will be of particular value to the Precambrian mapping program. The Division will be entitled to utilise up to one third of the available time on this machine, which is to be housed at Curtin.

The biggest problem facing the Division today is the lack of sufficient resources to meet the expanding geoscientific needs of the mineral and petroleum industries, which together constitute the economic foundation of this State. There has been little increase in staff since the mid-1970s, whereas the level of company exploration and the value of mineral and petroleum production has increased enormously (140%).

There was a precipitous decline in field activities from the mid-70s to the mid-80s, brought about by the great expansion of the mineral industry that occurred during that period, and the concomitant need for office-based geoscientific work to service industry requirements. Since 1986 there has been a determined push to increase the level of field work, and an 80% increase has been achieved since then, but the level is still far below that of the mid-70s. Indeed it is clear that field work will again decline if the industry continues to expand, and staff have to be taken away from field duties to carry out essential office-based work.

A major consequence of this situation is that the Geological Survey is unable to keep pace with the requirements of industry for updated geological maps, which are the fundamental basis for exploration in this State. Without such maps the quantity and quality of exploration in this State will inevitably decline.

During the year several activities were identified as of high priority, but progress was constrained by a lack of resources. These included:

- a backlog of 3 500 volumes of company data to be released onto open file;
- a significant delay in microfilming petroleum exploration interpretive reports before release to a private contractor for public dissemination;
- a need to upgrade field operations through the use of helicopters;
- the erection of modern core storage facilities; and
- the provision of appropriate storage for petroleum and mineral exploration magnetic tapes.

A significant event during 1990 that impacted on the work of the Division was the closure of the Drilling Branch. This came about as a result of the need for the Department to cut some $2.3 million from its budget for 1990-91. The eventual Government decision was made that this could best be achieved by closing the Drilling Branch, on the understanding that future drilling for the hydrogeology program would be carried out under contract.

The median age of staff in the Geological Survey Division has been increasing steadily over the past 10 years, and it is now 46 years. This has been brought about to a large extent by the unstable environment for employment of geoscientists in the mining and petroleum industries. Whereas in the past many staff would leave the government during successive booms, leaving vacancies to be filled by new graduates, staff are now less inclined to get involved in the boom-and-bust cycles of industry. Moreover, the merit-promotion scheme in place has been very successful in retaining good staff, some of whom might

GEOLOGICAL SURVEY DIVISION

THE YEAR IN REVIEW

otherwise have left. Because of these factors very few staff were lost during the recent gold boom, compared with losses of nearly one-third in the early 1980s and half during the nickel boom of the late 1960s. Attempts to overcome this situation will be taken whenever vacancies do occur, and the emphasis will be on the recruitment of new graduates.

The detailed activities of the Division are set out below using the Department's Corporate Plan programs and sub-programs as headings.

MINERALS AND PETROLEUM TITLES

Titles System

The Mineral Resources Section provided technical advice on tenements covering extensions of term, exemptions from drop-off conditions and alienation of land.

To clarify the requirements in the Act for technical reporting, two information pamphlets were issued.

Advice was also given on Mining Act matters discussed by the Mining Industry Liaison Committee including the new Offshore Minerals legislation, Special Agreement Act issues and releases of Ministerial Temporary Reserves for iron ore.

The Basin and Fossil Fuels Section provided technical advice to the Mining Engineering and Petroleum Divisions to assist in administering the appropriate Acts.

Dispute Management

The Environmental Geology Section provided general advice on Mining Act tenements with respect to conservation and Aboriginal issues as well as the co-ordination of Geoscientific Survey Permits.

General advice was provided on Petroleum Act matters with respect to access for exploration and development in areas with conservation value, particularly Marine Parks and Reserves.

Draft die-back control conditions are currently being considered by the Mining Industry Liaison Committee following consultation with CALM and industry groups.

The framing of exploration conditions and procedures for titles to be granted under the Minerals (Submerged Lands) Act were developed with the Environmental Protection Authority and Commonwealth Government.

EXPLORATION AND DEVELOPMENT OF NATURAL RESOURCES

Geological Data Collection

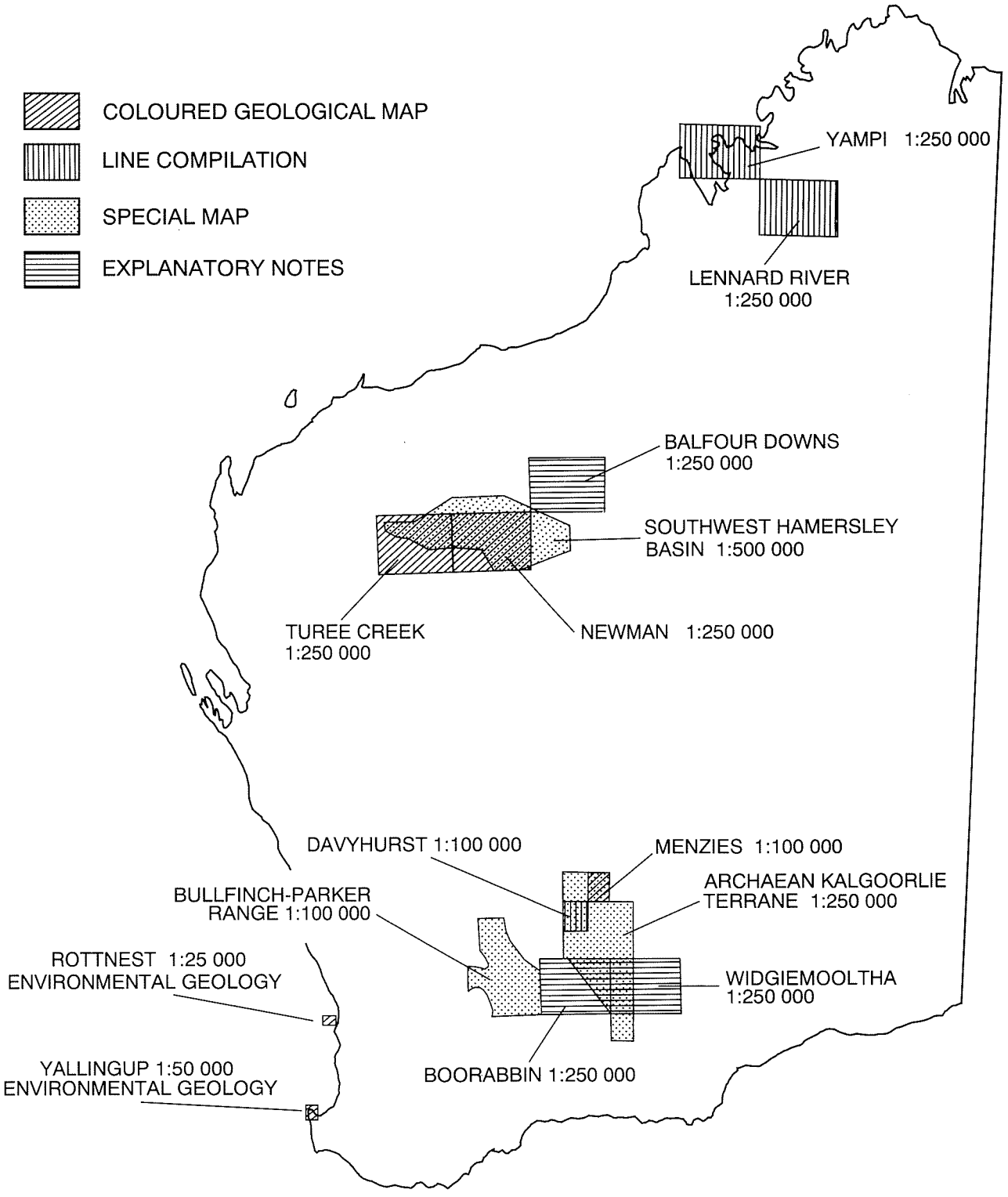
Progress achieved in documenting geoscientific information about the State in shown on the map opposite. This displays areas where data from Departmental studies have been integrated with information from mineral and petroleum exploration companies by the Geological Survey Division, reports written, and these data transformed by the Surveys and Mapping Division into printed maps available to the public. Some mapping was carried out with the Bureau of Mineral Resources under the National Geoscience Mapping Accord.

The map opposite demonstrates a recognition by Government of the need for geoscientific data at an appropriate scale for those areas of current or anticipated exploration interest.

It is clear that the intensity of information aggregated in reports and maps ranges from various degrees of regional synthesis (1:1 000 000, 1:500 000 and 1:250 000 scales) to detailed analysis (1:100 000, 1:50 000 and 1:25 000). This results from an appreciation by the Department of Government and industry's needs for the necessary degree of detail, as provided by the interchange of ideas through the Geological Survey Liaison Committee.

Other work in the Eastern Goldfields has seen the completion of a specialist study on Archaean mafic-ultramafic volcanic rocks and their associated mineralization between Menzies and Norseman and the commencement of a similar study on the felsic

MAPS AND EXPLANATORY NOTES PUBLISHED IN 1990-91



GEOLOGICAL SURVEY DIVISION

THE YEAR IN REVIEW

volcanic rocks of the Eastern Goldfields. Structural studies in the Kambalda and Kalgoorlie areas were continued and an external publication describing a thrust duplex was prepared. A geochemical study of the granites in the Kalgoorlie area continues and samples of various rocks in the Eastern Goldfields were collected and processed for future geochronological work. An external publication on porphyries in the Eastern Goldfields was prepared. The origin of laterite in an interior environment was studied in a joint project with CSIRO at Bottle Creek.

In the Southern Cross Province, map compilation, using experimental computer-based drafting, and accompanying geological (and geophysical) notes were completed for the Cheritons Find 1:100 000 sheet. This work included an interpretation of the aeromagnetics of the Parker Dome. Mapping commenced on the Ravensthorpe 1:100 000 sheet.

Study in the Murchison Province culminated in the publication of Bulletin 137 describing the geological evolution and mineralization of the province. Geochemical data from the Murchison study was released on computer diskette. A special 1:100 000 map covering the Warriedar fold belt was completed.

Work continued in the Western Gneiss Terrane.

Regional gravity mapping of the southeast Yilgarn Craton continued. The revised Bouger anomaly map of the Collie Basin with explanatory notes was published. Data processing of the Dinninup 1:100 000 map was completed and explanatory notes were written. Data acquisition in the area covered by the Darkan 1:100 000 map sheet commenced.

Explanatory notes to the Newman 1:100 000 sheet and Newman 1:250 000 sheet were released as records and explanatory notes to the Paraburdoo 1:100 000 sheet were written. A report on a geochemical and mineralogical study of banded iron-formation and associated sedimentary and volcano-sedimentary rocks in the Weeli-Wolli core hole was completed. Field work was completed on the Fortescue Group and on the Pearana and Braeside 1:100 000 sheet areas. Field work was also completed on the review of the geology and mineral potential of the Hamersley National Park.

A joint National Geoscience Mapping Accord mapping project with BMR was commenced in the Halls Creek Orogen and mapping was carried out on the Angelo and Dockrell 1:100 000 sheet areas.

In the Paterson Orogen, the compilation and geological notes of the Broadhurst 1:100 000 sheet were completed and work commenced on the Rudall 1:100 000 sheet area. SHRIMP geochronology was carried out on three samples from the Rudall Complex.

Bulletin 139 describing the geology of the Ashburton Basin in the Capricorn Orogen was published and a report written on the stratigraphy and stromatolites of the Nabberu Basin in the Glengarry 1:250 000 sheet area.

Field work in the Savory Basin was completed and a 1:500 000 scale map on the basin compiled. A first draft of a bulletin of the basin was completed.

Several staff were involved in the preparation of excursion guides and the running of successful geological field excursions, organised as part of the 3rd International Archaean Symposium. Poster presentations were also made at the Symposium on U-Pb zircon geochronology in the Pilbara and the geology of the fault-bound terranes and domains in the Eastern Goldfields.

Field work and data compilation has commenced for a review of the mineral occurances of the Albany 1:1 000 000 sheet.

The rock and mineral data system of the Geological Survey is continually updated. Currently a committee, including members from the University of Western Australia and CSIRO, is investigating geochemical aspects of the system. It is hoped that the system,

established as a geographically-based data storage system, can be expanded to cater for the storage and manipulation of associated geochemical data.

Geochronology

Work continued in the Department on the geological dating of rocks in the north west of the Yilgarn Craton. Sampling of rocks in the south west corner of the State revealed a geological event at 450 to 500 million years which was probably associated with continental breakup at that time.

Mineralisation Studies

The petrography and chemistry of mafic dykes was studied in the vicinity of Williams, an area of good outcrop. The study provides a firm basis for the study of dykes further west where engineering requirements make it important to distinguish mafic rocks of the basement complex from the later dyke swarms.

Basin Studies

A geophysical study of the southern Perth Basin was completed, as was geological mapping of the Arrowsmith and Hill River sheets. New projects commenced included a comprehensive review of the geology and geophysics of the northern Perth Basin, and a study of Jurassic sequences in the southern North West Shelf.

Geophysical mapping of the subsurface of Phanerozoic basins continued. A series of 1:250 000 scale seismic structure maps at various horizons was completed for the onshore and offshore portions of the Canning Basin. Sheets showing seismic structure onshore at base Grant Group have been published at this scale and at 1:1 000 000, and are available on floppy disks. In addition, a 1:1 000 000 map showing the Pre-Grant Group geology has also been published. A number of seismic structure contour maps in the southern Carnarvon Basin were also released.

Seismic mapping of the Chinook, Scindian, Griffin and Ramillies oilfields in the offshore Carnarvon Basin was undertaken to assist the Petroleum Division in estimating petroleum reserves.

Geological advice was provided on the Hill River and Collie coalfields. The geological study of the Collie Coalfield is nearing completion, with the production of computer-generated structural cross-sections.

A preliminary report was written on the Quaternary palynology of Barker Swamp, Rottnest Island, and a joint paper on the stratigraphy of the Glengarry Group, Nabberu Basin was prepared.

Hydrogeology

With the closure of the Drilling Branch, future drilling for groundwater resources assessment will be carried out by contractors. From July 1990 to the time of closure in October that year, 53 bores had been drilled with an aggregate depth of 6 013 metres.

Deep drilling was carried out at Karridale Line 6 bore, which was drilled to 1 605 metres, completing the drilling of a line of deep bores in the southern Perth Basin. The results further confirmed the existence of very large fresh groundwater resources in this region.

The Leeman and Scott coastal plain drilling programs were commenced and work was subsequently suspended prior to completion. In the Leeman project 37 bores with an aggregate depth of 2 452 metres were drilled at 18 sites. The work disclosed the presence of larger fresh groundwater resources than anticipated. In the Scott Coastal Plain project 15 bores with an aggregate depth of 1 955 metres were drilled at five sites. The drilling extended the known extent of the fresh groundwater resources in the southern Perth Basin and provided valuable information on intake and recharge areas.

Assessment of results and preparation of reports on the groundwater resources of the

GEOLOGICAL SURVEY DIVISION

THE YEAR IN REVIEW

Eastern Goldfields (Roe Palaeodrainage) and Collie Basin were completed.

Preparation of the draft of the Derby hydrogeological map and explanatory notes was completed. Compilation and preparation of explanatory notes for the Kalgoorlie, Kurnalpi, Widgiemooltha and Boorabbin hydrogeological maps in the Eastern Goldfields has also progressed steadily.

Work was carried out for the Water Authority supervising and assessing results of drilling for Carnarvon, Exmouth, Horrocks Beach, New Norcia, Halls Creek, Piawanning, Watheroo, and Leonora town water supplies.

Geoscientific Data Dissemination

The Geological Survey maintains a number of geoscientific databases, and work continued on updating WAMEX (mineral exploration data), WAPEX (petroleum exploration data), MININFORM (mineral resources and reserves data), ROCKMIN (petrological data), and the geophysical and hydrogeological databases. A review of ROCKMIN is being undertaken to enable it to be expanded to cater for the storage and manipulation of associated geochemical data.

During the year 2 766 mineral exploration and 675 petroleum exploration reports were received. The number of reports made available to the public on microfiche was 1 898.

In the Museum, several educational and historical displays were prepared, school visits were catered for, and rock and mineral sample sets were supplied to schools.

During the period under review there were 5 132 visitors to the library of whom 1 590 used the microform reading and printing facilities. Staff loans totalled 791 and a total of 634 inter-library loans were arranged. Items sent to other libraries on inter-library loan totalled 146.

Extensive public use of microfiche indexes to the mineral and petroleum exploration open-file reports continued, and there were 85 on-line searches of the WAMEX database and 16 searches of the WAPEX database.

Numerous enquiries on a wide range of topics were dealt with during the year. Areas covered included information and assistance for prospectors, urban geology for land-owners, mining and its environmental implications, and educational geology for teachers and students.

The geoscientific data made available by the Geological Survey Division on microfilm and microfiche, together with its maps and publications, provide a valuable information base for industry and contribute towards maintaining a favourable climate for exploration. The value of maps and publications sold amounted to $162 766 while microfilm and microfiche sales realised $102 684.

A Western Australian basins seminar was conducted at which a number of papers on the geology and petroleum potential of several sedimentary basins was presented by Department, Bureau of Mineral Resources and industry speakers. This was arranged to coincide with the very successful Petroleum Technology Australia 1990 Oil and Gas Expo which was held in Perth.

A field excursion was organised to the Carnarvon Basin in August 1990 and a new field guide prepared for this area. The trip provided representatives from the petroleum industry with the opportunity to observe and examine the types of sedimentary units to be found in the subsurface elsewhere in the basin.

Geological Survey Division staff presented several papers at the International Conference on Groundwater in Large Sedimentary Basins and ran successful field excursions for the 3rd International Archaean Symposium held in Perth. The Division also prepared a display for the joint Geological Society of Australia/Society of Exploration Geophysicists conference in Sydney.

GEOLOGICAL SURVEY DIVISION

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A total of 73 publications including 54 maps were released during the year. Memoir 3, Geology and Mineral Resources of Western Australia, representing the culmination of 15 years' work by the Geological Survey, was one publication that attracted special attention. More than 600 copies had been sold by 30 June 1991 and it is expected that the Memoir and the maps that accompany it will be standard reference works for years to come. The memoir comprises a volume of 827 pages with three maps and a stratigraphic table.

During the year the Mineral Exploration Data Subsection received 2 766 new exploration reports bringing the total number to 32 900, representing 8 126 projects. Of these, 21 063 volumes on 4 394 projects involve, wholly or in part, exploration for gold. A total of 1 411 volumes were released on microfiche, bringing the number of open-file reports to 11 586, representing 4 447 projects.

During the year work continued on a revised version of the WAMEX exploration data indexing system. The Departmental module is planned to be completed in late 1991. The industry module should be available in March 1992.

The Petroleum Resources Subsection continued with its main tasks of accessioning, microfilming and releasing of exploration data. A total of 675 reports were received from industry during year. In the same period there were 487 reports placed on open file; these include data from 174 surveys and 215 wells.

The Mineral Resources and Economic Subsection was extensively engaged in data maintenance of its MININFORM, mineral resources inventory, and core data of the

Geological Survey geologists Guy Le Blanc Smith and Roger Hocking (right) assessing the economic potential of fossil fuels in two of the State's most significant production areas – the North West Shelf and the Collie coalfields.

corporate MINEDEX, deposits and mines information system. The MINEDEX system now holds data covering nearly 2 400 deposits or minesites on over 1 300 integrated mineral projects. A report was prepared on the nickel industry and its resources in Western Australia.

The Gravity, Geophysical Well Log and Aeromagnetic data indexes were updated and made available to the public on request. A new search and display program for the Aeromagnetic Data Index ("Magcat") was developed.

Geotechnical And Mining Engineering Advice

The demands to provide advice to industry, Government and the broader community continued to grow. Specifically, geotechnical, hydrogeological, environmental and engineering advice has been accelerated by new technological achievements, expansion in the industry, environmental awareness, health and safety moves by Government, and a range of socio-political factors.

Geotechnical advice was provided to the Water Authority, Westrail, and the Main Roads Department. Geotechnical and rock mechanics advice has been provided to the Mines Inspectorate on open pit and underground mine safety. Cooperative research programs with industry, University of WA and Curtin University have also been instigated to address aspects of mine safety. Advice given to the Water Authority and Main Roads Department includes construction of the new Victoria Dam; investigations of potential damsites at North Dandalup, Margaret River, Manjimup, and Conjurunup; and quarry sites in the Murchison and Norseman areas.

Ground investigation was carried out in the Meckering area after the earthquake in January 1990. The results were reported in the Record series.

Seismic refraction surveys were conducted for the Water Authority at the proposed Conjurunup damsite and further seismic work was done at the North Dandalup damsite. A seismic refraction survey for the Main Roads Department was completed at proposed road cuts along the Brookton Highway. Interpretation of the North Dandalup damsite seismic refraction survey was completed.

A position paper on Local Government and Basic Raw Materials Extraction was prepared in conjunction with the Department of Local Government.

The Hydrogeology Section continued to provide extensive advice to other Government agencies, consultants and the general public. During the period 1 January 1990 to 30 June 1991 a total of 540 telephone enquiries, 289 counter enquiries, and 12 inspections for bore-siting were dealt with.

Up to six hydrogeologists (three on secondment) worked on Water Authority matters, providing various advice and assistance. In particular, work was carried out supervising and assessing results of drilling for Carnarvon, Exmouth, Horrocks Beach, New Norcia, Halls Creek, Piawaning, Watheroo, and Leonora town water supplies.

The Section co-operated with the Department of Agriculture in a drought relief drilling program in the Kimberley District after continuing drought conditions. Bore sites were selected, and drilling supervised, on eight stations in November 1990. The stations were located in very difficult areas for groundwater resources and only seven successful bores (25% success rate) were located.

The Geophysics Section carried out magnetic and electromagnetic surveys for groundwater exploration at Watheroo and Halls Creek.

Community Relations

Aboriginal Liaison

Since 1984 an Aboriginal Liaison Officer has materially contributed to the Department's role of ensuring that all Western Australians receive

maximum benefit from the exploration and development of minerals and petroleum.

The officer conducts workshops and provides advice to Aboriginal communities, to exploration and mining companies and to Government. The acute awareness by Aboriginal communities of the potential effects of exploration and mining upon their physical and social environment has resulted in the Aboriginal Liaison Officer being in continuous demand for both advice and as a negotiator between the various parties. The officer also undertakes policy reviews regarding land access and land-use.

Aboriginal communities and mining and petroleum companies have drawn on these services over recent years, many on an on-going basis.

Industry Reviews

The Mineral Resources Section and Kalgoorlie Regional Office provide ongoing advice to the public and other government departments on various commodity, mineral potential, mineral exploration and development matters. Most significantly, mineral resources reports were compiled on various industrial mineral commodities and papers prepared on the overview of the industry and reviews of exploration in Western Australia. These papers included presentations to the Chamber of Mines and Energy annual conferences, AusIMM proceedings and the Government Geologists Conference.

The Environmental Geology Section undertook geoscientific work to assist the CIB inquiry in relation to the investigations at Karpa Springs. A geotechnical report has been completed and ongoing assistance provided in the cross-checking of samples and analyses.

ENVIRONMENTAL PROTECTION AND REHABILITATION

Exploration and Mining

The Environmental Geology Section provided advice on land-use studies for the Department of Planning and Urban Development, and regional planning exercises by CALM.

The section prepared a report for the Quarry Rehabilitation Work Party and prepared a set of rehabilitation guidelines and draft by-laws.

The section also represented the Department on the Coastal Management Coordinating Committee, The Gnangara Mound Technical Group, and the Integrated Catchment Management Group.

Assistance and general advice in the preparation and technical appraisal of environmental assessment documents was undertaken in conjunction with the EPA.

Preliminary fieldwork was carried out as part of an assessment of the Dundas Nature Reserve.

The Basins and Fossil Fuel Section provided written advice and maps in connection with several areas, including the proposed Mt Lesueur National Park, the Ningaloo Reef Marine Park, the proposed Monte Bello Marine Park, and possible SECWA line corridors from Pinjar to Hill River.

Groundwater

The Hydrogeology Section prepared reports on various groundwater pollution incidents. In particular a field study of groundwater pollution plumes around some 60 disused landfill sites in the metropolitan area was commenced on behalf of the Health Department. An inventory of actual and potential point sources of pollution was compiled and provides the first overview of the possible severity and extent of pollution in the Perth Basin. The compilation of a groundwater vulnerability map of the Perth Basin is well advanced. A study of the amount of nutrients entering the ocean near Perth from groundwater was compiled and showed that groundwater was a minor contributor of nutrients. Studies are continuing on the quality

of road run-off entering the shallow aquifer from infiltration basins in the metropolitan area.

A number of studies relating to land salinization were undertaken. Nineteen bores with an aggregate depth of 332 metres were drilled in the Upper Denmark Catchment to investigate the control of shear zones on land salinity; this project was undertaken in co-operation with the Department of Agriculture as part of an Integrated Catchment Management.

COMMUNITY BENEFITS

The Mineral Resources Section provided geological and mine economics advice to assist in the negotiation and collection of mineral royalties.

WORKER AND PUBLIC SAFETY

Geotechnical Studies Related to Health and Safety

Specialist geotechnical advice was provided to the Mines Inspectorate. Studies and assessments were provided on over 80 open-pit and underground mines. In addition to advice on geotechnical matters, research programs on the long-term stability of open pits and method of ground on support design on underground mines were initiated. A seminar on open-pit stability was held in five centres in the Eastern Goldfields, Yilgarn and Murchison in August 1990, attended by over 300 mining industry personnel. Guidelines on the location of bund walls around abandoned open pits were issued in January 1991.

The Engineering Geology Section has given numerous technical presentations on rock mechanics and the geotechnical aspects of open-pit and underground mines.

Seminars on open-pit mine stability were given to the Regional Councils of the Chamber of Mines in June and July 1990.

A seminar on open-pit mine stability was presented in Southern Cross, Kalgoorlie, Leonora, Mt Magnet, and Meekatharra during August 1990. The day-long seminar included representatives from consulting geotechnical engineers and mining companies and was aimed at open-pit mine operators. Approximately 400 industry, union, and mining contractor personnel attended the seminars.

Presentations were made to the WA Mining Club and Geomechanics Society (Institute of Engineers) on the abandonment of open-pit mines, as well as lectures to the Institute of Surveyors, Australasian Institute of Mining and Metallurgy, and the Western Australian School of Mines.

CORPORATE SERVICES

A principal role of the Geological Survey's Corporate Services group is to assist the Directorate in management of the five-year geoscientific program. It is also responsible for laboratory, clerical, word processing, computer, and occupational health and safety services, and the provision of vehicles, equipment and support staff to geological field parties. The section also organises and monitors conferences and training courses attended by geological staff, and work-experience programs for students.

With the new Commonwealth Government Training Guarantee Scheme in which employers must spend a minimum of 1% of payroll on staff training, it is necessary to ensure that training is in accordance with the new guidelines. Staff requests for training have been compiled from this year's performance reviews. These lists will be used to ensure that both professional and support staff attend appropriate training courses and conferences that are both relevant to the individual's career development and necessary for the efficient operation of Geological Survey programs.

Following the closure of the Drilling Branch, the Stores and Transport Section began transferring material from the Morley Store to

its permanent location at the Department's complex at Carlisle. By mid-June 1991 all of the publications store had been transferred, and a start was made on transferring the field stores and equipment. The move should be complete by August 1991.

Major improvements in the field of occupational health and safety included the installation of 25 Barrett transceivers in field vehicles, replacing radios which were up to 17 years old. An ongoing protective clothing allowance for 65 field staff was also negotiated.

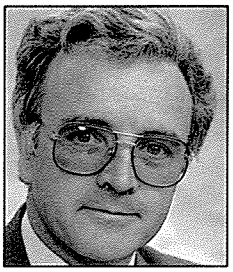
In the area of information technology, five desktop and four laptop computers and ancillary equipment were installed in various sections of the Geological Survey. In addition, a complete desktop publishing system was purchased for the Publications and Information Section. This system will be used for in-house preparation of Geological Survey reports, bulletins and other publications.

Encouraging Petroleum Exploration: Ways and Means

" It is not just the presence of petroleum resources which makes Western Australia attractive, it is the hard work and enthusiasm of the Department of Mines in promotion and administration."

Aggressive exploration for new petroleum resources must be encouraged at every opportunity, if Western Australia is to achieve its goal of expanding its energy reserves.

And, as part of the challenge, there needs to be a solid contributory effort by the three major parties involved — the Federal Government, the Government of Western Australia and the petroleum industry itself.



Mr I (Ian) Fraser, BSc (Hons)
Director, Petroleum Division

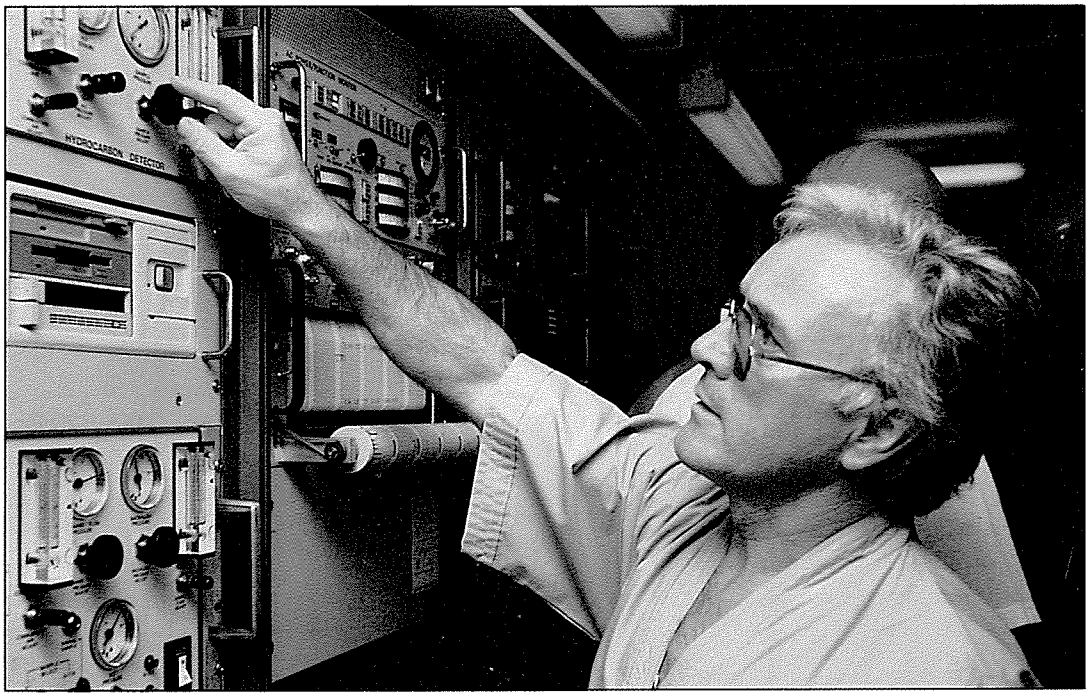
The Director of the Petroleum Division, Mr Ian Fraser, believes that a good working relationship already exists among these parties. However, there is always room for improvement in certain areas.

He said participants must continue to recognise the diverse nature of the petroleum industry, including the viewpoint of explorers, producers, marketers and contractors, as well as the world-wide competition for exploration dollars and the priorities of governments and the community.

The petroleum sector makes a significant contribution to the wealth and energy supplies of Western Australia. It is vital that petroleum resources are exploited in a way that ensures a fair return to both the community and the petroleum industry.

Key areas in which the Government can affect the industry include land access, acquisition of petroleum rights, work safety, environmental protection and information disclosure.

These policy areas fall within the mandate of the Department of Mines. The Department continually reviews methods of encouraging



The Director of the Petroleum Division Ian Fraser during an inspection visit to the offshore drilling rig Maersk Valliant.

and facilitating responsible exploration and exploitation.

Mr Fraser said that through this Annual Review, the public could see that the Petroleum Division was acting to encourage resource development while ensuring safe working conditions and environmental protection.

Legislative, regulatory and administrative requirements serve to clarify the rights and responsibilities of industry. It is also extremely important that these requirements are both practical and achievable.

Mr Fraser said a number of amendments had been made to legislation to ensure that companies retained rights to discoveries they had made, and to maximise the probability for the State that these resources would be developed.

These amendments are discussed in more detail in this volume, but include the introduction of Retention Leases, whereby an explorer may retain tenure over discoveries which are presently non-commercial.

To encourage development of marginal fields and cater to sensitive environmental zones, new legislation has been introduced to allow production from wells located outside the actual licence. For example, in some circumstances the wellhead can be sited outside sensitive environmental locations and the hole deviated to reach the target, such as drilling from islands to discoveries beneath important marine habitats.

"The division's pragmatic approach to changing and administering legislation has encouraged operators to come forward with new exploration and development ideas," Mr Fraser said.

"This assists the Division in facilitating the work of the industry.

"In terms of the day-to-day functioning of the industry, the Division maintains communication with the industry and unions with regard to safety issues. This was demonstrated with changes to safety administration following the Piper Alpha disaster.

"We are strongly involved in reviewing techniques of exploration and production so as to maintain a minimal environmental impact and offer a focal point for discussions of these issues.

Mr Fraser said the Petroleum Division also encouraged the gathering and distribution of information which was imperative for the development of new ideas in exploration. Changes had been made to legislation so that the scope of Access and Special Prospecting Authorities was extended, facilitating seismic acquisition. Similarly, interpretive data from previous exploration may now be made available to new explorers."The effectiveness of these measures can be partially gauged by the high level of interest in exploration within Western Australia, especially when one considers the subdued nature of the economy," he said.

"This interest is demonstrated by the arrival of new companies, some taking on offshore operations in Australia for the first time. It is also manifested by the large number of areas awarded in the past year, and the commencement of large exploration programs in relatively under-explored areas such as the Bonaparte and Perth offshore areas.

"It is not just the presence of petroleum resources which makes Western Australia attractive, it is the hard work and enthusiasm of the Department of Mines in promotion and administration. The Department will continue to strive to assess and realise the potential of these resources and achieve economically and environmentally-sustainable development."

PETROLEUM DIVISION

THE YEAR IN REVIEW

INTRODUCTION

Seven petroleum discoveries were made this year and indications are that the year has marked the beginning of a new phase of exploration in the State.

Oil discoveries were made by Ampol at Wandoo 1, by Lasmo at Leatherback 1, by BHP at Ramillies 1 and by Petroleum Securities at Boundary 1. Gas was discovered at Yodel 1 by Woodside, Scindian 1 by BHP and Ocean Hill 1 by Arrow. Further work is needed on some to determine whether they are commercially viable.

Large exploration programs have commenced for the permits awarded last year in the less well-known offshore Bonaparte and Perth Basins, with exploration seismic surveys and the spudding of the Tuart 1 well.

Access to exploration acreage continued to be promoted by the Department. Growing interest in exploration investment in the State was demonstrated by an increase in drilling activity and a 100% increase over last year in the number of new permits awarded. Thirty-three areas were gazetted and 16 awarded. The gazettals were the result of the biannual releases of Commonwealth areas, industry requests for onshore acreage and the commencement of quarterly gazettals of all vacant onshore acreage.

The Yammaderry, Cowle and Boundary oilfields came into production during the year and work progressed on the Goodwyn, Tubridgi, Cossack, Campbell, Sinbad, Rosette and Beharra Springs development projects.

More detailed notes on the Petroleum Division's activities are presented below using the Department's Corporate Plan program and sub program headings.

PETROLEUM TITLES

Titles System

The year marked a major change in the policy for onshore acreage gazettals, (islands not included). In October 1990 all vacant acreage in the Canning Basin was advertised, inviting companies to apply for exploration permits of a size, shape and location of their choice (within certain limitations). This system allows the industry to assess areas of interest from a broad range, rather than concentrating attention on pre-selected areas. The policy was extended in April 1991 to include all vacant areas in Western Australian sedimentary basins. This new policy was designed to encourage a more even spread of exploration activity.

This gazettal policy was complemented by the introduction of the Petroleum (Drilling Reservations) Amendment Act 1990, which came into effect on 1 March 1991. Applications were invited in April for Drilling Reservations which are small, short-term authorities with a one well commitment.

At the end of the year there were 139 petroleum titles in Western Australia, 96 exploration permits, 22 production licences and 21 pipeline licences. Administration of these titles includes documentation of all company interests and their transfer, approval of activities and review of title conditions (work or financial commitments).

Thirty-three areas were advertised for application involving 31 discrete permits and the two broad releases described above. Sixteen new permit titles were granted, eight onshore and eight offshore. The award of Perth Basin permits advertised in the second offshore realease are pending. Their release attracted 10 applications for eight of the 12 areas advertised.

Compilation of basic data has commenced on a computer system to improve data handling and customer service, although at a rate slower than anticipated due to funding cut-backs.

Dealings and Fee Collection

To be recognised under the various Petroleum Acts, title dealings and transfers

must be approved and registered at the Department of Mines. This assists in minimising disputes over title interests. During 1990-91 the Division processed and applied fees to 343 dealings and transfers of interest documented in the title registers. Some 550 title searches of these legal records were undertaken during year.

The system of fee collection ensures that consistent and appropriate rates are applied. Fees calculated and requested include those for applications of all types, registration of dealings and transfers, and annual title fees.

The Petroleum Division advises on petroleum legislative matters and clarifies intepretation and policy. It also recommends changes to legislation where appropriate. During the year a number of amendments were gazetted and proclaimed. Changes to the State Acts contained in these amendments are detailed in Appendix 1.

EXPLORATION AND DEVELOPMENT OF NATURAL RESOURCES

The Petroleum Division encourages responsible exploration for the State's petroleum resources, ensures exploration and development practices are appropriate, that petroleum resources are conserved, and that knowledge of the State's petroleum geology is increased

Geological Data Collection

The Division continues to collate exploration data and information on new petroleum discoveries and producing fields. This information is analysed to improve knowledge of the State's petroleum resources.

Daily reports were reviewed for 76 petroleum wells drilled during the year (33 exploration and 43 development) and petrophysical analyses were performed on the Wandoo, Leatherback, Ramillies, Yodel, Scindian and Boundary discoveries.

Production data from the 22 developed fields in the State were collated and statistics generated. This data has been used to assess the volume of gas flared in the State and can be used to evaluate potential future production.

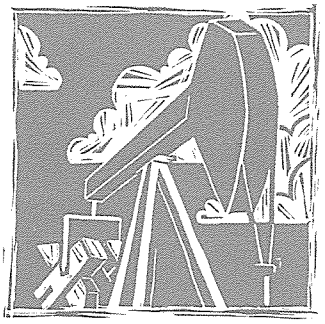
Independent assessments of production management and reservoir engineering studies were performed on the Rosette gas field and Saladin oil field. A reservoir engineering interpretation of the Griffin-Chinook area was undertaken , including reservoir analysis, petrophysical evaluation and a PVT (pressure-volume-temperature) study of fluids.

Geoscientific Data Dissemination

The Petroleum Division provides an information service to the State Government, industry and the community about the exploration and production industry and its activities. As well as answering ad hoc queries, the Division publishes "Petroleum in Western Australia" which contains general background information on legislation, taxes and so forth; reviews and forecasts of permit activity, seismic surveying, drilling, development and production; editorial comment; plus technical papers and other data for national and international circulation. This year one volume was issued with special features including a directory of companies involved in the local industry and a chart of data on all producing fields including field facilities, wells, production and dates.

Acreage available for exploration was promoted by early notification to a large audience and by encouraging speculative seismic surveys.

The Petroleum Division co-ordinated a joint exhibit with petroleum exploration companies working in the State at the International Petroleum Technology Expo at the Burswood Convention Centre between 21 and 24 November 1990. Poster exhibits and models displayed the functions of the Department of Mines with respect to petroleum title allocation,



exploration trends, petroleum discoveries and production facilities, safety, environmental protection, royalties and other aspects of the industry in this state. As well as reaching industry representatives, the public was able to view this exhibition on an open day, while a large number of staff from the Department took advantage of the free direct bus service to learn more about this important resource industry.

Geotechnical and Mining Engineering Advice

The Petroleum Division co-ordinates the processing of applications for approval of operations. The number of applications for operational activities (mainly seismic surveys and the drilling of wells) continued at a steady rate.

All applications were assessed for safety, technical merit, formation evaluation procedures, and environmental management procedures to comply with "good oil field practice", to set conditions, and advise on possible alternatives where applicable.

Each of the exploration and development wells was monitored during drilling and requests for testing and completion reviewed. This included petrophysical analysis, approval of testing parameters and engineering surveillance.

The Division continued to interact with the industry on new development activities. Development plans were assessed for application of good reservoir management practices to ensure maximum long-term return on the State's known petroleum resources. Technical advice was given with regard to the approval of applications for Production Licenses and Retention Leases, and on engineering design elements.

Community Relations

The Division encourges responsible exploration and exploitation of the State's petroleum resources. Means of fostering interest in the industry are discussed in the lead article of this section.

ENVIRONMENTAL PROTECTION AND REHABILITATION

Petroleum Operations

A Senior Environmental Officer was appointed to the Division to ensure minimum impact of the environment by petroleum operations. This is being achieved in a number of ways inlcuding:

- providing advice to petroleum companies regarding government environmental legislation and directives. Companies are also advised of any existing environmental constraints on their tenements. A number of environmental guidelines are provided to assist them in planning their environmental management program;
- activities and rehabilitation programs of petroleum companies are monitored and frequent offshore and onshore field inspections are conducted to ensure compliance with the environmental approval conditions; and
- a Petroleum Conservation Consultative Committee, chaired by the Senior Environmental Officer, was established to provide dialogue between government bodies, petroleum companies and conservation groups on environmental issues in petroleum exploration and development operations.

Groundwater Resources

To ensure protection of groundwater resources from contamination by higher salinity fluids from other strata intersected during drilling, Petroleum Division staff ensured adequate surface casing for all wells drilled onshore. This surface casing must be cemented to surface or, in some cases, top-up remedial cementation is required. On completion of drilling operations, plug back cement plugs must be set and tested to ensure

no cross communication between formations of different salinities can occur.

Prospectivity and Impact

The Division is reviewing the prospectivity of the Monte Bello Islands area and likely exploration methods, to assist the Government in assessing an appropriate method of environmental management.

COMMUNITY BENEFITS

The Petroleum Division monitored metering devices for custody transfer and provided technical advice on the calculation of royalties which, during the year, generated total government revenue of $126 million.

WORKER AND PUBLIC SAFETY

The Petroleum Division has responsibility for ensuring that petroleum exploration and development operations are carried out in a manner which ensures the occupational health and safety of the workforce and safety of the public.

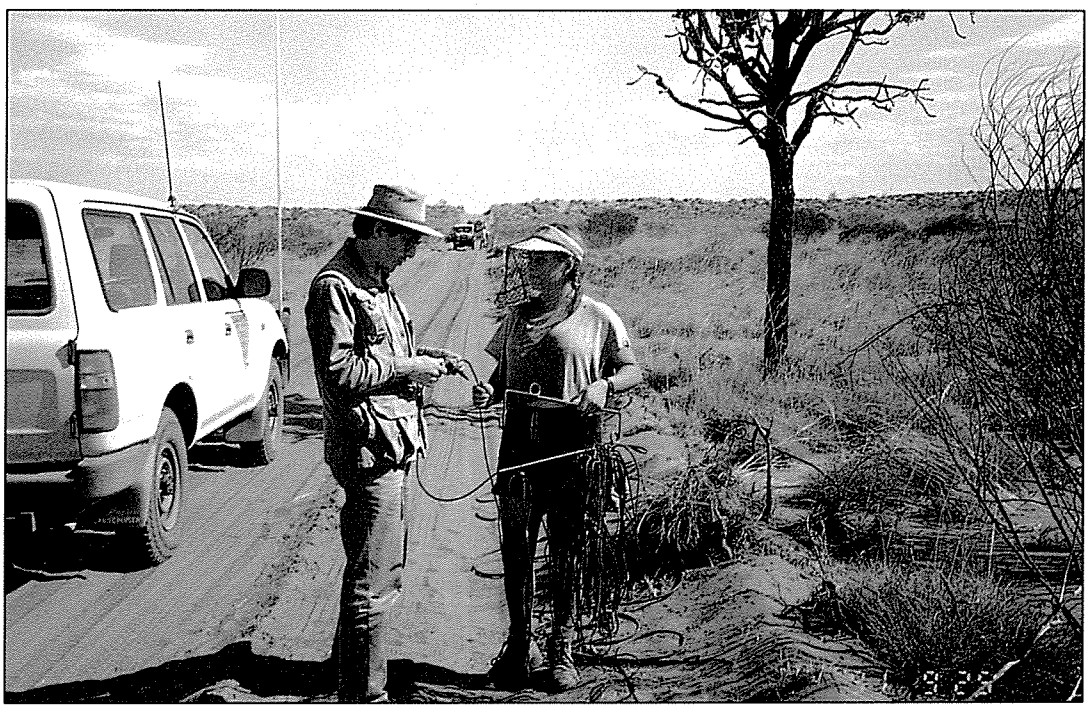
Worker health and safety

Australian and, where appropriate, international safety standards are required to be met or exceeded by the oil and gas industry in this State. Legislation requiring adherence to these safety standards has been enacted and is reviewed and updated by the Petroleum Division as required.

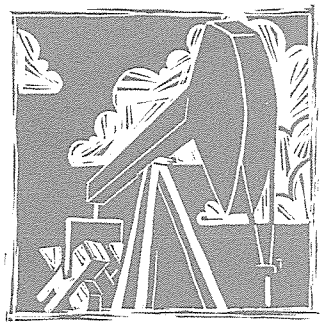
During 1990-91 a new Schedule of Onshore Exploration and Production Requirements was finalised after extensive discussions with industry. Both this and the new Pipeline schedule will be issued formally early in the new operating year.

Industry and union comments were sought at a meeting, held in Perth in April, concerning recommendations arising from the Cullen public enquiry into the U.K. Piper Alpha disaster and proposed changes in legislative requirements to enhance the occupational health and safety of workers in the industry.

Initiatives are being taken to introduce certain specific requirements of the Occupational Health, Safety and Welfare Act



Newly-appointed Senior Environmental officer Jimmy Seow travelled far and wide during the year to liaise and check with petroleum companies on precautions to protect the environment during exploration programs. Here he inspects progress of seismic survey work carried out for Shell Development (Australia) Pty Ltd in the Great Sandy Desert.



PETROLEUM DIVISION

THE YEAR IN REVIEW

1984 to reinforce the general duty of care/good-oil-field-practice provisions in the current Petroleum and Pipeline Acts.

Approvals and Inspections

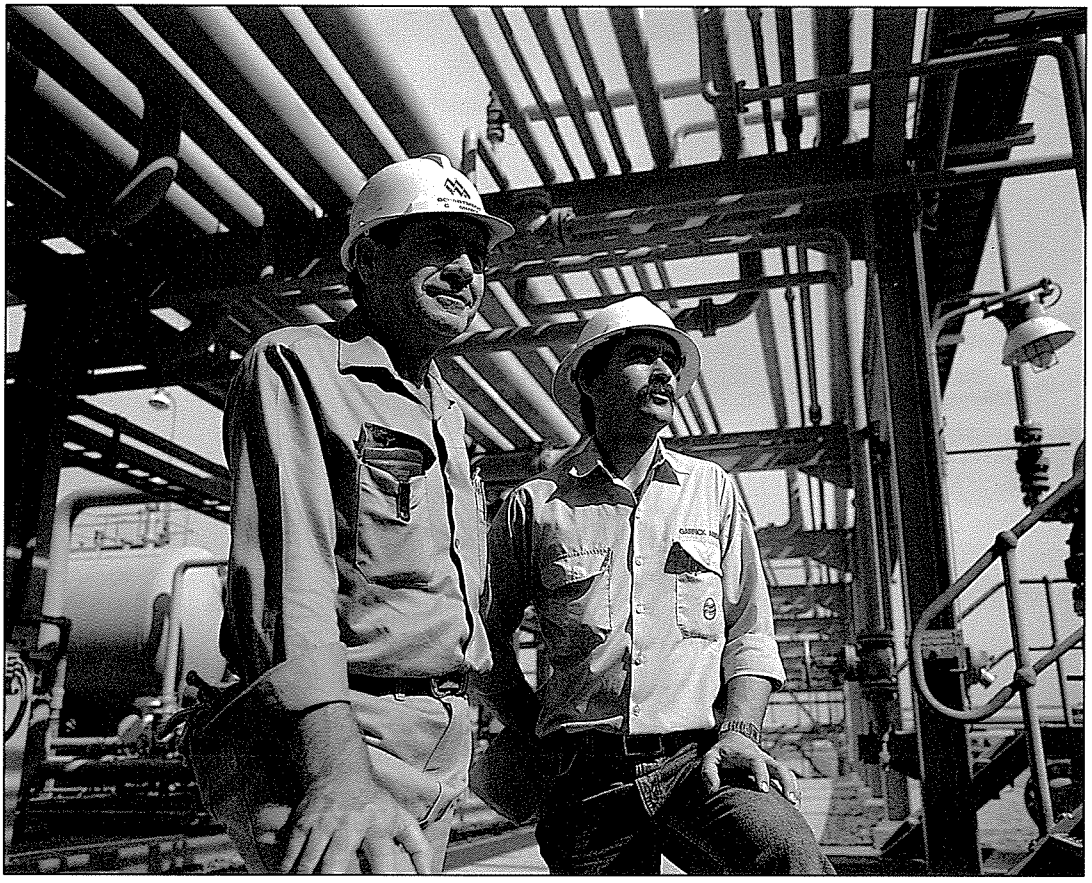
Activities are monitored to ensure that procedures and equipment meet safety standards include seismic surveying, well drilling, pipeline laying, underwater diving, production operations and new field developments. All applications for operations presented this year were assessed and advice provided where necessary. As these operations proceeded, inspections or other audit methods were applied. The prevention of well blowouts is of primary concern. Standards for courses in blowout prevention have been established and industry participation in the courses is required.

During the year 53 inspections were carried out by the Petroleum Division inspectorate, compared with 45 in the previous year. This reflects the increase in exploration activity and the larger number of fields in production during the period.

Safety Record

While the number of manhours worked in the petroleum industry increased over last year by 24%, the number of lost-time injuries (LTI's) increased by only 3%. This represents a decrease in the accident frequency rate, a measure of LTI's per million hours worked, from 27 in 1989-90 to 22 in 1990-91. Two fatalities were recorded during the review period.

Offshore operations continue to have a better safety record than onshore operations due to the higher priority placed on safety by operators in the offshore environment. Implementation of the new Schedule of



The Petroleum Division's Inspectorate carried out 53 inspections during the year, including this one by Deputy Director Keith Gammie (left) to WAPET's oil storage facility on Thevenard Island. With him is WAPET's Construction Engineer Garrick Aberle.

Onshore Exploration and Production Requirements combined with increased surveillance of onshore operations by the inspectorate should help to redress this situation.

Public Safety - Pipelines

The Division continued to monitor the inspection and maintenance of existing and planned pipelines and production facilities to ensure that risks to the public are minimised. In general, petroleum pipelines represent a low area of risk to the general public, however, annual post-cyclone surveys of offshore pipelines were carried out by all operators. This resulted in certain remedial measures being taken, such as Woodside's $60 million retrofit to its 134 kilometre pipeline from the North Rankin A platform to the LNG plant at the Burrup Peninsular to improve its stability on the sea bed during cyclones.

Stringent design requirements were implemented on the new pipelines which were built this year. A new draft Schedule of Specific Requirements as to the Design, Construction and Operation of Petroleum Pipelines has been issued for industry review and will significantly upgrade the existing 1970 regulations. More field inspections have been undertaken this year as an additional step in the control of public safety.

CORPORATE SERVICES

Support to the Division was provided by two additional staff on temporary secondment from the Drilling Branch to assist with the heavy workload generated by increased petroleum exploration and development activity. This has also been acknowledged by the allocation of an extra engineer to supplement the staffing level of the Engineering Branch.

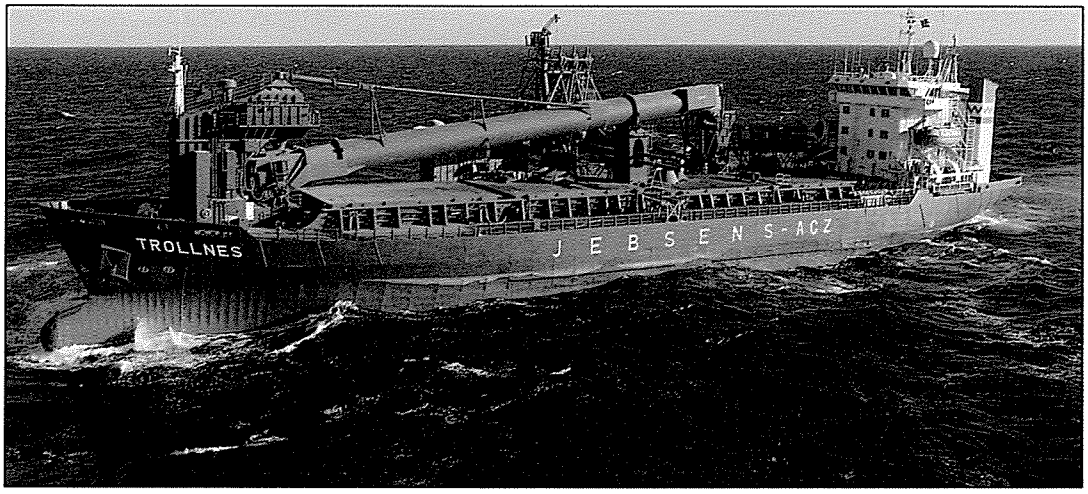
Computerisation

The Division documented its strategic Information Technology (IT) plan and implemented an education and IT training program for staff members. Databases were developed for handling basic title information and safety statistics.

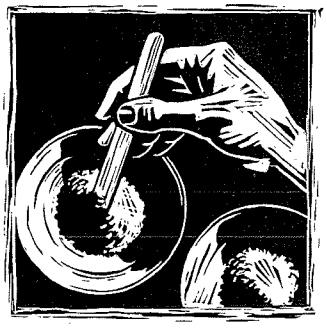
Training

In May the Deputy Director attended a South East Asia Regional Safety and Environmental Workshop in Jakarta sponsored by the Oil Industry International Exploration and Production Forum.

Also during the year, the Assistant Director attended training courses in Total Quality Management and a Hazard and Operability Study (HAZOP) course held in Perth.



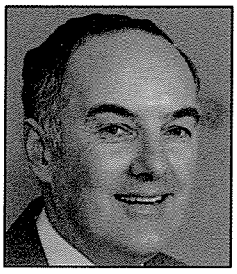
Trollnes, the flexible-fall pipe, rock-dumping vessel used for Woodside's seabed pipeline stabilisation project on the North West Shelf.



New Process for Treating Copper in Gold Ores

" ... another example of how Chemistry Centre staff have used their experience and expertise to assist in the development of a new mineral process."

One problem frequently encountered during the extraction of gold by cyanidation is the presence of soluble copper in the ore. Soluble copper reacts with cyanide resulting in losses of this expensive reagent. Further, in carbon-in-pulp (CIP) circuits the copper can be loaded on to the activated carbon together with the gold causing problems further down the circuit. An increasing number of Western Australia gold operations are encountering ores containing significant quantities of copper.



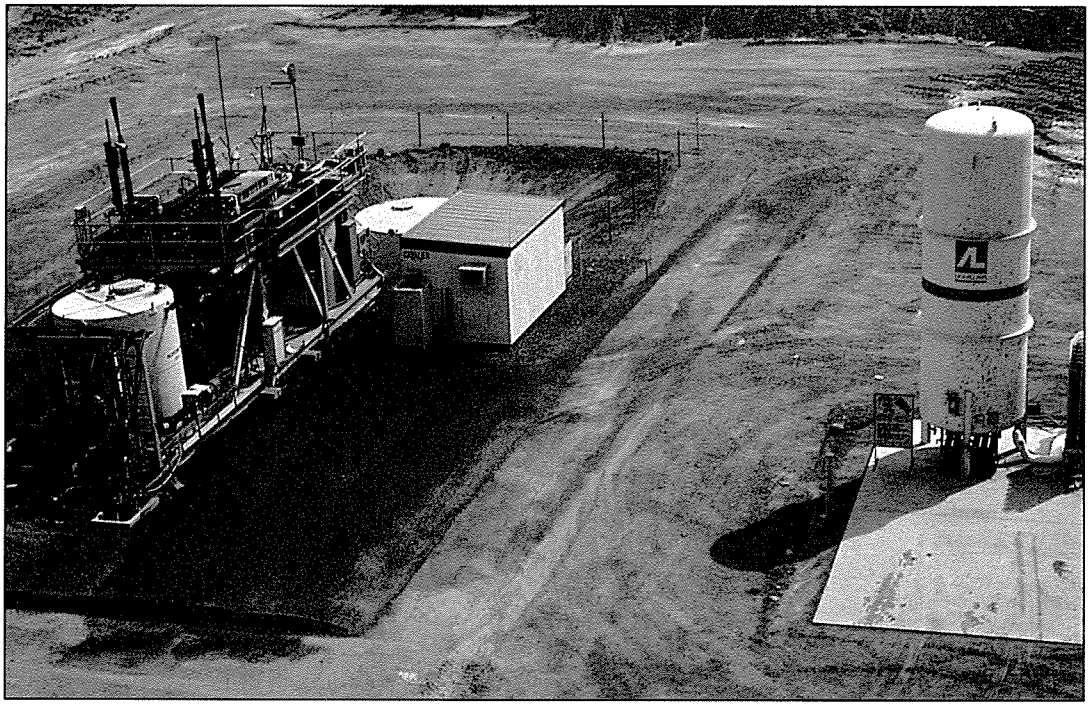
Dr JW (John) Hosking MSc PhD, FAusIMM, FRACI Director, Chemistry Centre (WA)

During the past year, the Mineral Processing Laboratory of the Chemistry Centre has been assisting local companies to develop a process which may result in many high copper gold operations being able to significantly cut operating costs. The idea was the brainchild of Mr Bruno Sceresini, Principal Metallurgist with Australian Mining Advisors.

Mr Sceresini said that in most gold plants where high copper levels are a problem, conditions in the CIP circuit were adjusted to try to limit the amount of copper loaded onto the carbon.

"Although this may help in alleviating problems later during recovery of the gold, significant quantities of cyanide are still lost and simply carried to the tailings dam by the dissolved copper," he said.

"Even worse, the copper which has been sent to the tailings dam is returned with recycled water to again react with cyanide. If the copper is present at high concentrations, direct cyanidation of the ore may become uneconomic."



The copper recovery section of the Mt Gibson gold project, 300 km north east of Perth.

He thought that instead of trying to limit the loading of copper onto the carbon, a better approach would be to take advantage of this property of the carbon and use the carbon to capture and remove the copper from solution at the beginning of the CIP circuit. Once the copper had been removed from solution, the rest of the circuit would be operated as a normal carbon-in-pulp process to recover the gold. The copper would be stripped from the carbon together with the associated cyanide, the copper recovered in some suitable form for sale, and the cyanide recycled to the leach circuit.

Following discussions between Mr Sceresini and Chemistry Centre staff, a three stage process was investigated, with the work being funded by Mt Gibson Gold Project, an operation which does have soluble copper. In the first stage, carbon was used at the front of the CIP circuit to remove the soluble copper from solution. Pulp conditions in this part of the circuit were adjusted to favour the adsorption of copper by the carbon. This carbon was then removed from the pulp and the contained copper stripped from the carbon to produce a concentrated copper-cyanide solution. Stripping of the copper was accomplished using concentrated cyanide solution at ambient temperature. The carbon was then returned to the circuit.

In the second stage the copper-cyanide solution was acidified using sulphuric acid, resulting in the precipitation of a copper cyanide salt. During this process most of the cyanide bound with the copper was released into solution. Following removal of the precipitate, the pH of the solution was adjusted and the recovered cyanide returned to the leach circuit.

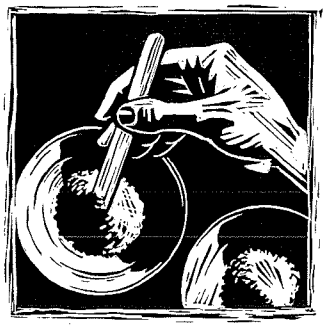
In the final stage, the copper cyanide salt was placed in a sulphuric acid solution. Using heat and oxygen the solid was digested to produce a copper sulphate solution. At this point some additional cyanide was recovered and recycled. The copper sulphate can be sold. In a six month period from July 1990, this proposed copper/cyanide recovery process was evaluated in the laboratory and a plant was designed and installed at the Mt Gibson Gold Project at a total cost of approximately $1 million. The operations of this first installation are still being evaluated, with the continuing involvement of Chemistry Centre staff. The willingness of the Mt Gibson Gold Project partners, Forsayth N L and Reynolds Australia Metals, to invest a considerable sum of money in this new process illustrates that the Western Australian mining industry is open to new ideas.

"This was another example of how Chemistry Centre staff have used their experience and expertise to assist in the development of a new mineral process," said the Director of the Chemistry Centre, Dr John Hosking.

"Our staff were able to work with the consultant and his idea, use their knowledge of metallurgy and chemistry and develop a new process which will allow more efficient exploitation of the State's mineral resources," he said.

Work is continuing in the Mineral Processing Laboratory to explore variations of the process and its application to other copper-gold ores and even to the treatment of low grade copper deposits.

As Mr Sceresini observed: "In-depth knowledge of copper-cyanide chemistry, which has been acquired during our investigations may be useful in dealing with copper deposits where CIP can be used to upgrade the ore and effectively produce a copper product of some form."



CHEMISTRY CENTRE (WA)

THE YEAR IN REVIEW

INTRODUCTION

Services provided by the Chemistry Centre during the year included scientific support for the development of the State's mineral, water and agricultural resources, for the monitoring and improvement of public and occupational health, environmental and materials standards within the community as well as for the law enforcement and racing agencies.

Increased resources were devoted to Quality Assurance during the year. An in-house National Association of Testing Authorities (NATA) seminar was attended by all senior staff and in part by professional and technical staff. Emphasis was placed on upgrading methods and laboratory operations manuals to meet with the new NATA standards. In addition the range of Chemistry Centre activities accredited by NATA was expanded.

The Centre continues to hold a high profile among its peers and staff continue to play prominent roles in the activities of the Chemistry profession. During 1990-91, the Director of the Chemistry Centre, Dr John Hosking, was elected National President of the Royal Australian Chemical Institute and represented the Institute at the 13th meeting of the International Chemical Society Presidents and the 150th Anniversary of the Royal Society of Chemistry Conference held in London. Mr V McLinden, Coordinator, Forensic and Environmental Chemistry, stepped down after six years as President of the International Association of Forensic Toxicologists, a term which culminated in his chairing of the meeting in Perth, the first to be held in the southern hemisphere. Mr Grant Ferguson, Senior Chemist and Research Officer in the Materials Science Laboratory, was elected National Chairman of the Polymer Division of the Royal Australian Chemical Institute and Mr Neil Campbell, Chief of the Forensic Science Laboratory has been appointed to the inaugural Panel of Advisors of the newly formed National Institute of Forensic Science.

The Chemistry Centre further improved its financial management and reporting systems in 1990-91. While industry, members of the public and revenue producing Government agencies are charged at a rate which ensures full cost recovery, other government agencies have been informed since 1 July 1990 of the full cost of each investigation. Government clients were notified with each report of the non-chargeable cost of their work. This cost was calculated to be the full cost and includes salary, salary on-costs, running and equipment costs and rent.

Further modifications have been made to the building to improve safety and occupational health conditions. Major problems were encountered during renovations to house new equipment; asbestos fibres from degraded asbestos cement fume cupboards were accidentally distributed through some laboratories. This problem will place restrictions on future building renovations and maintenance.

Funding was not allocated to the Chemistry Centre Bentley complex in 1990-91. A proposal for a staged building program for the transfer of the Mineral Processing Laboratory and Hay Street facilities to Bentley was put to Government for funding in 1991-92.

More detailed notes on the Chemistry Centre's activities are presented below using the Department's Corporate Plan program and sub program headings.

EXPLORATION AND DEVELOPMENT OF NATURAL RESOURCES

Mineral Science Laboratory

Significantly increased requirements for analytical data by government and industrial clients were catered for by the Laboratory throughout the year. Increased output and quality of analytical data provided to the Geological Survey of Western Australia were

consistently achieved in support of their on-going programs. All clients benefited from improvements made possible by developments in quality assurance systems within the Laboratory. The mining and minerals industry was actively supported, not only with accurate analytical chemical and mineralogical data, but also by advice and problem-solving collaborative projects. The Mineral Science Laboratory became increasingly more pro-active throughout the year resulting in an enhanced professional interaction with industry and the private sector.

The Laboratory has become increasingly involved in the chemical and mineralogical analysis of gold. Determination of impurities to 'fingerprint' the gold, using laser-ablation inductively coupled plasma-mass spectrometry (LA-ICP/MS) has generated strong interest among the police both throughout Australia and overseas. The main application is in comparison and identification of the sources of gold involved in gold stealing cases.

Special Services

During the year, the Laboratory undertook the characterisation and analysis of a wide range of ores and materials. This often required the development of new methods to overcome analytical interference problems particularly at the low detection levels required.

The acquisition of an inductively coupled plasma mass spectrometer (ICP-MS), at the end of the operating year, will allow the Laboratory to significantly reduce detection limits for a variety of elements. This advantage will, however, be significantly impaired if blanks cannot be reduced. This problem results from the inadequate purity of chemicals and associated contamination by virtue of open beaker dissolution. To overcome this problem a laboratory microwave system was purchased. The sample is heated by microwaves in sealed plastic vessels with the minimum volume of acid. A number of dissolution procedures have now been developed to improve sample throughput and to facilitate the transference of analytical methods to the ICP-MS system in 1991-92.

Geochemistry

The Philips X-ray spectrometer was fully commissioned, providing continuous 24-hour analytical facilities for a wide range of materials. By the end of March, the backlog of samples, generated by nearly two years of below-par instrument status, had been eliminated.

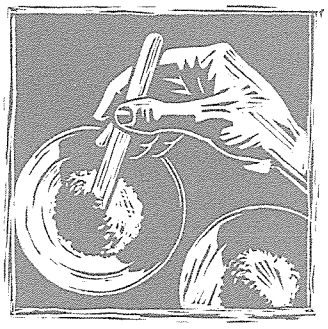
Software, for collation and reporting of client results, has been upgraded to provide more efficient and cost-effective operations.

A number of investigations were also undertaken by the Geochemistry Section during the year. Investigations into sulphur retention, in high sulphide samples, have resulted in a significant modification of existing methodology. Indications are that the use of water, instead of complicated fluxing and oxidising mixtures, ensures the efficient admixture of components. This mixing allows intimate inter-grain contact and facilitates quantitative oxidation and sulphur retention.

Mineralogy

Throughout the year the Mineralogy Section maintained a significant involvement in public health issues, with emphasis on asbestos and mine dusts. Forensic activities, particularly in relation to gold stealing, rose sharply and new initiatives in process mineralogy were implemented. A new, automated X-ray diffractometer was installed in the latter half of the year. Computer facilities associated with this unit include a CD-ROM database system of reference diffraction data. This system is being developed to provide automated mineralogical identification of unknown materials.

The Simpson Mineral Collection continues to provide a unique and invaluable scientific reference base for mineral exploration



companies and academics. Two dedicated field trips to the Eastern Goldfields were undertaken to collect the oxidised expression of gold ore bodies. Together with some company and personal donations of minerals, this led to the addition of a further 1 120 specimens to the collection.

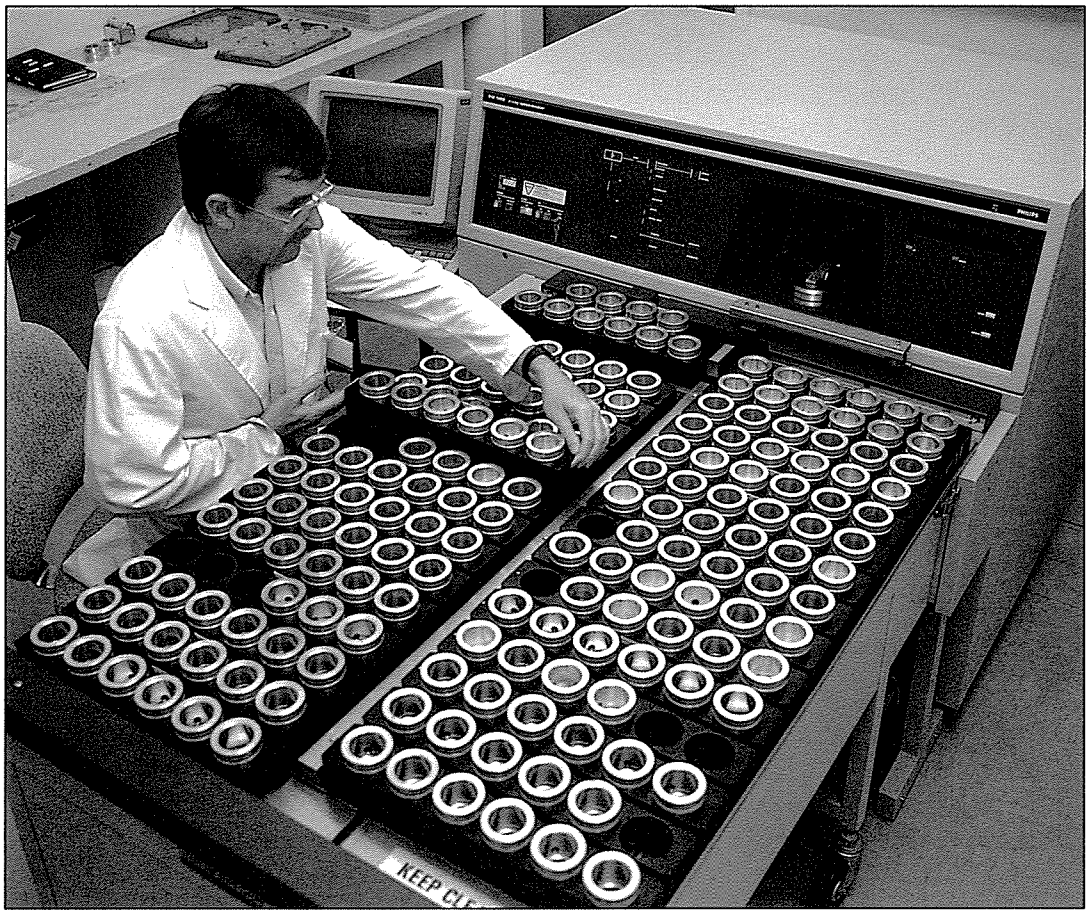
Asbestos and asbestos products in the community and mine environment continued to cause concern. Officers of the Laboratory made significant contributions to the identification of asbestos in a wide range of materials for a variety of government and non-government clients, and provided analytical input to the findings of the Expert Working Party on Asbestos Cement Products (WAACHS).

Mineral Processing Laboratory

The Laboratory's client base continued to expand locally, nationally and internationally as its unique capabilities became more widely recognised by the mining industry. These achievements were particularly notable, given the decreased resources available for servicing clients and reflect the efforts of the Laboratory's technical and professional officers in safely and efficiently completing projects under less than ideal conditions.

Pilot Scale Kiln Trials

Several continuous kiln campaigns each involving one-to-three weeks of shift work were carried out on behalf of local and interstate mining industry clients. Tonnage quantities of product were produced for further



Mineral Science Laboratory chemist Richard Clayden loading samples on to the laboratory's new X-ray spectrometer.

evaluation. Most of the interest was in the assessment of mineral sands concentrates as feedstocks for the production of reduced ilmenite for conversion to synthetic rutile. In addition, the first in a series of kiln trials was carried out to convert a mineral processing byproduct to a paint pigment. Availability of the kiln was enhanced by the upgrading of working conditions including an air conditioned control room, improved process control equipment and a general ongoing refurbishment program.

Other Mineral Test Work

Research and development work for a local metallurgical consultant has resulted in a process which has now been commercialised. The process enables gold ores containing high levels of soluble copper to be economically treated. A full-scale plant has been commissioned at a West Australian gold mine and work is continuing on evaluating the process for other ore bodies. Advantages of the process include recovery of copper as a soluble by-product and recovery and re-cycling of cyanide previously lost to tailings. The new process has been reported in the press and some details have been presented at conferences and seminars.

Advice on the recovery of gold from a refractory concentrate from China resulted from the Chemistry Centre's new scanning electron microscope facility and the metallurgical expertise of the Laboratory. As in previous years the Laboratory continues to provide non-routine CIP troubleshooting and evaluation of activated carbons for the gold industry.

Other major client projects completed during the year in non-gold areas included the upgrading of a graphite ore and the development of a roast/leach flowsheet for recovering uranium from a mineralogically unusual ore body. A range of small to medium size investigations for clients was completed, including:

- the behaviour of mercury during regeneration of activated carbon;
- upgrading of discoloured kaolinite clay;
- sterilisation of overseas mineral samples using the Laboratory's newly licensed quarantine facilities;
- chemical and mineralogical analysis of lime samples;
- preparation of acid soluble titania and synthetic rutile from overseas mineral sands concentrates;
- cyclone beneficiation of iron ore slimes;
- referee analysis of xanthate flotation reagent; and
- chlorine leaching of refractory gold concentrate.

Workshop Activities

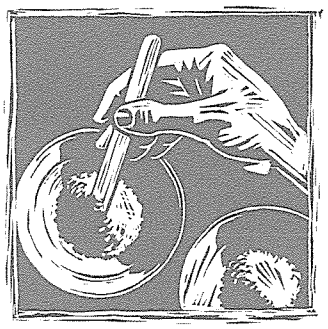
The major activity through the year was in supporting metallurgical test programs, in particular the pilot scale rotary kiln and its associated support equipment and buildings. Work for other Chemistry Centre laboratories has increased over the last year and widened in scope in line with the expanded range of equipment.

Funded Research Projects

A new collaborative project involving the Laboratory and a local instrument manufacturer, Chemtronics Ltd, has commenced. This project is funded under the National Procurement and Development Program of the Commonwealth Government and its aim is to develop an automated on-line gold and cyanide analyser.

Kalgoorlie Metallurgical Laboratory

The Laboratory has continued to have difficulties in recruiting and retaining qualified and experienced staff due to its remote location and the low salary compared to those paid by the local mining companies. Despite these difficulties the Laboratory continued to provide



metallurgical consulting services to the local mining industry in the areas of evaluation of new processes, flow sheet development, plant surveys, process optimisation and trouble shooting. The Laboratory also provided other services including bullion analysis, assistance in gold stealing cases and fire assaying.

Metallurgical Testing

The effect of the downturn in the mining industry caused a reduction in the number of samples submitted to the laboratory for ore characterisation and in metallurgical testwork. Ore samples were subjected to specific gravity, heavy media and magnetic separation, flotation, carbon reactivity and hardness testing, size analysis and cyanidation.

Pilot plant flotation and gravity and magnetic separations were also undertaken.

Bullion Analysis

Nearly 3 000 samples from gold bullion bars from local gold producers were analysed for gold and silver, with results provided within 24 hours.

Fire Assay

Over 500 metallurgical and umpire samples and samples for court evidence were analysed for gold by the classical fire assay procedure.

Research Project

The Laboratory in conjunction with the WA School of Mines (WASM) was successful in attracting MERIWA funding ($136 000) for two years to carry out research work on "Column Flotation Studies of Complex Sulphide Ores of Western Australia". There are four industry sponsors for this project. Research and development projects on "Bubble Size Measurement in Two and Three Phase Systems in Column Flotation", "Separation of Arsenopyrite and Pyrite for Concentrates by Batch Flotation", "Determination of Gold and Silver in Activated Carbon by AAS" and "Heap Leaching Characteristics of Western Australian Gold Ores" were completed in 1990-91.

Collaboration

A high level of collaboration with WASM was maintained in 1990-91. This has been valuable in terms of exchange of technical information and advice, involvement with graduate student projects and with joint research proposals. Laboratory staff continue to assist by lecturing and running courses for WASM.

ENVIRONMENTAL PROTECTION AND REHABILITATION

Environmental Chemistry Laboratory

Staff from the Environmental Chemistry and Mineral Processing Laboratories continued their involvement in a multi-client investigation coordinated by AMIRA which concluded on 30 June. This project, "Fate of Cyanide in the Environment Near Mine Tailings", has 14 sponsors and a budget of $250 000 for the two and a half year study. One meeting of sponsors which discussed the project results was held at a sponsors mine site. Visits to sponsors mine-sites (in Western Australia, Queensland and the Northern Territory) have been made by Chemistry Centre officers employed on the project.

During the year the Environmental Chemistry Laboratory also became involved in other projects relating to the investigation of cyanide residues around tailings disposal areas. One interesting case involved a tailings disposal area in Victoria where the client wished the Chemistry Centre to do the work following a successful investigation into a similar problem in Western Australia.

CHEMICAL SERVICES

Agricultural Chemistry Laboratory

Laboratory Instrumentation

The capacity of the Laboratory has been considerably increased by the commissioning of new instrumentation which features the capability of unattended overnight operation.

The Inductively Coupled Plasma Atomic Emission Spectrometer has multi-element and single element modes. In the single element or sequential mode the desired lines can be selected manually. The simultaneous mode has 29 elements selected permanently with nine being of particular interest to Agricultural Chemistry. This arrangement allows maximum flexibility but retains the rapid throughput from reduced instrument reading times for the commonly-analysed elements.

A Leco Nitrogen Determinator has been purchased and is operational. This instrument has the advantage over the classical methods for nitrogen determination because it uses a combustion rather than an acid digestion technique to convert the nitrogen. The process generates nitrogen gas only; other gases are absorbed. The throughput of a sample every three minutes, with extended run times and compact profile, without a bulky fume extraction system makes this instrument a very useful acquisition.

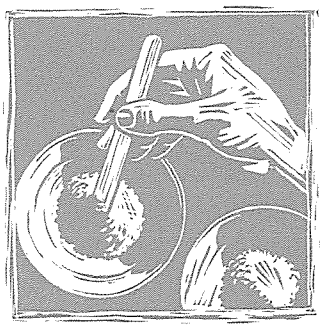
A Graphite Furnace Atomic Absorption Spectrometer has also been added to our analytical systems. This instrument is fitted with Zeeman background correction which allows simple sample preparation for most analyses and therefore quicker turn-round times.

Funding was obtained via the WA Department of Agriculture from agricultural research bodies for the total cost of the Leco Determinator and for half the cost of the Inductively Coupled Plasma Atomic Emission Spectrometer.

Lupin Research

The monitoring of the material from the lupin breeding program for protein and alkaloid levels continues. The value of this work to the industry was recognised by the Grain Legume Research Committee's

Sophie Sipsas, a chemist in the Department's Agricultural Chemistry Laboratory, collects sap from a lupin crop at Wongan Hills, as part of a special research project to monitor levels of alkaloids in the breeding lines of lupins.



recommendation that this project be funded on a long-term basis.

A project on the extraction of alkaloids and the isolation and purification of individual alkaloids has made substantial progress. Good stocks of lupanine and 13-hydroxy lupanine are held, while the methodology for the separation of the less common angustifoline and alpha-isolupanine has been developed.

The alkaloid profiles of fifty two cultivars of eleven lupinus species were determined.

Soil Compaction Studies

During the year the Agricultural Chemistry Laboratory carried out tests relating to soil compaction, especially damage caused by tractors and agricultual implements. It established that important parameters in soil compaction were moisture content during compaction, organic matter content of the soil and the content of particles less than one millimetre in diameter.

Dam Soils

Soils from the North Dandalup Dam area have been analysed. Cation exchange data showed that a number of these soils had a very high proportion of exchangeable magnesium, with low exchangeable calcium. This coupled with pH and salinity information confirmed a potential dispersivity. The design and construction to overcome these potential problems will have considerable impact on the cost of the project.

WACA Wicket

Investigation of the problem of cracking in the main wicket area of the WACA has shown that very high clay contents in the soil are the major problem. Effort to ameliorate the effect of the high clay content by using gypsum to obtain smaller cracking as the wicket dries has had some positive effect. Investigation of alternative sources of wicket forming clay have been undertaken throughout Western Australia.

Soil Ionic Strength

The ionic strength of the soil solution has a marked effect on the measured soil solution properties such as pH and cation exchange capacity. The results from this work show that Western Australian agricultural soils give soil solutions with an ionic strength of about .01M, with sodium as the dominant cation.

Environmental Chemistry Laboratory

Staff continued to work with officers of other government agencies to monitor, evaluate and advise on the quality of the Western Australian environment. Community concern with issues such as the quality of underground water supplies resulted in increased monitoring of potential pollution sources such as tipsite leachates. State and local government agencies are now involved in monitoring underground water close to tipsites for a range of nutrients, metals and organic pollutants which (if present) could affect the health and well being of members of the public. Air pollution is a topical issue and joint projects with the Environmental Protection Authority are underway to develop a better understanding of the quality of Perth's atmospheric environment.

Environmental Monitoring

Major areas of activity for this section included:

- atmospheric and water contamination by trace organic compounds;
- monitoring of nutrient pollution in waterways for Health Department, EPA and Waterways Commission;
- heavy metal contamination of waterways resulting in potential health risks due to build up in the food chain;
- incinerator emission monitoring to investigate the quality of atmospheric emissions; and

- cyanide speciation for mining industry clients to allow better understanding of the processes occurring in tailings dams.

Pesticides

This section was again under strong workload pressure to provide monitoring services and advice to the Health Department on issues concerning pesticide residue contamination in waters, foodstuffs and the atmosphere. Specific projects undertaken included:

- a survey of nursing mothers' breastmilk, blood and body fat for levels of organochlorine pesticide residues;
- examination of locally grown fruits and vegetables for a range of pesticide residues;
- regulatory monitoring of licensed pesticide operators and their chemical usage;
- monitoring of herbicide runoff from plantation areas for Conservation and Land Management officers;
- an investigation into any fenitrothion contamination following the Agriculture Protection Board's locust eradication program; and
- a survey with Waterways Commission and Health Department into organochlorine pesticide contamination in fish in the Swan River.

Water Resources

This Section continued to work with the Water Authority and Geological Survey to investigate the quality of potential underground water sources. Other major areas of activity were:

- examination for the Health Department of commercially available mineral waters for compliance with the Food Code labelling requirements;
- advice to the public on swimming pool treatments, hydroponics, bore waters and corrosion problems (approximately 1 000 enquiries); and
- investigation of cooling water problems in major hospital air conditioning systems. Problems include corrosion and algal growth control.

Forensic Science Laboratory

A strong demand in major programs has continued in each of the three operational sections of the Laboratory.

The overall increase in case numbers for 1990-91 was 7.5%. The following table details the growth in demand for forensic services over the past three years.

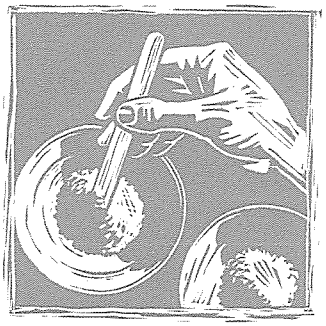
TOTAL CASES RECEIVED

	1988-89	1989-90	1990-91
TOXICOLOGY			
Coronial	570	825	858
Fatal traffic	237	236	189
Criminal	96	99	94
ILLICIT DRUGS			
Illicit drugs	652	816	997
Alcohol/drugs	549	565	510
Prison health services	410	408	524
PHYSICAL EVIDENCE			
Arson	118	98	103
Total other exhibits	159	125	159

In October 1990 the 27th meeting of the International Association of Forensic Toxicologists (TIAFT) was held in Perth. It was an excellent opportunity for staff to interact with international experts in this discipline.

Presentations on cannabinoid detection in urine, cannabis and driving offences, toxicological screening techniques and analysis of volatile substances by gas chromatography - mass spectrometry given by the Laboratory's staff, were well received.

Immediately following the Perth meeting, the International Association of Forensic Science (IAFS) conducted its triennial conference in Adelaide.



material which blocked filters in a milk processing line, causing production delays and potential replacement of expensive filter media.

Consumer Products

A significant increase in air quality testing has highlighted the need for high purity air in the recreational and industrial diving fields. Apart from regular monitoring for commercial air suppliers, investigations were carried out for the police and port authorities. Carbon monoxide was detected in several samples requiring reviews of compressor operation, while one of the fatalities investigated showed a cylinder filled with nitrogen instead of air.

Community Education

Laboratory staff were increasingly involved with community education in the area of chemical safety. Apart from the Ventilation Officers Seminars and public enquiries, lectures were given to a variety of government and private employees on all aspects of chemical use in field and industrial situations.

Occupational Hygiene

The survey of staff exposure to anaesthetic gases and sterilising agents in metropolitan and country hospitals continues. Most assessments resulted in recommendations for upgrading of equipment or ventilation. A joint project with hospital staff involved the redesign of oxygen masks used in recovery rooms. This will improve scavenging properties and reduce atmospheric levels of waste anaesthetic gases.

Chemical safety inspections were undertaken of Pilbara, Kimberley, Goldfields and Collie mine sites.

Assistance was given in chemical storage and handling procedures, plus the correct choice of protective equipment. A similar program was undertaken for CALM Research Centres in Perth and the country.

Field work for CALM involved assessment of employee exposure to timber control herbicides during tree-notching operations. Exposure was very low, but recommendations were made on the redesign of the applicator used to dispense the herbicides. Talks were given to field staff on handling hazardous chemicals.

During the year the State Health Laboratory Services recognised the Chemistry Centre as their agent in the area of monitoring biological materials. This enables medical practitioners to refer directly to the Laboratory. Analysis and interpretation of results are now undertaken on over 20 heavy metals and organic chemicals in biological specimens.

Quality Assurance

The Laboratory organised and monitored inter-laboratory quality assurance programs in meat analysis for those WA private laboratories intending to obtain public analysts registration. Similarly, the Laboratory participated in a variety of inter-laboratory QA/QC programs and sought to increase its terms of registration under NATA.

Materials Science Laboratory

The Laboratory consults to government and industry on corrosion and building problems, consumer products and material failures.

Materials for Potable Water

The Laboratory continues to conduct tests to determine the suitability of coatings, fittings, sealants and liners which come into contact with potable water. The process simulates actual industry usage and provides practical information for the Health Department to determine approvals.

Cleaning and Polishing Products

A Western Australian mining company commissioned the Laboratory to conduct tests on 20 industrial-grade cleaning products used against five types of oil and grease found on site. The object of the investigation was to determine which cleaning agent was the most effective and most cost efficient. Worker and

environmental safety was a major consideration in the selection of a product and also the mode of application. The final selection was a water-based product, applied by high pressure foam jet and containing minimal amounts of phosphate.

Two tenders involving cleaning and polishing products were amalgamated this year. A review of major users and suppliers, by State Tender Board officers provided information on items to be removed and added to the tender. Because of increasing community concerns, new tender specifications have been stengthened to improve user safety, environmental safety, ease of use and effectiveness.

Building Technology

A range of investigations was conducted on problems associated with the building industry including the suitability of painting systems for concrete structures, efflorescence on blockwork and a variety of quality controls on subcontracted building work.

Fretting brickwork on a $500 000 private residence was jointly examined by Mineral Science and Materials Science Laboratories for Ministry of Consumer Affairs. The cause of failure was determined to be underfired bricks.

Polymer Investigations

An investigation was conducted into the failure, after only 12 months, of the surface coating (polyester gelcoat) on a fibreglass crayfishing boat. It was determined that the gelcoat contained a lead/chrome pigment which was known to be toxic and photodegradable when exposed to ultraviolet light. It was recommended that the failures be repaired with a polyester filling compound, the hull sanded and top-coated with a marine grade (UV resistant) polyurethane surface coating. Special safety precautions were indicated for the re-coating because of the toxicity of the lead/chrome pigment in the original coating.

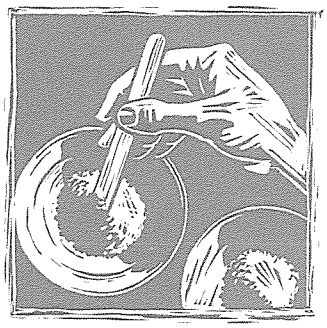
A postgraduate student from Curtin University of Technology submitted a Masters degree thesis on Photodegradable Polyethylenes. This was jointly supervised by Curtin University and Grant Ferguson from the Materials Science Laboratory.

Corrosion

The Laboratory is continuing the investigation of factors contributing to corrosion. The salt spray cabinet (an accelerated corrosion test) has operated for most of the year. Provision of advice to government and the private sector was on the suitability of materials in harsh environments, assessment of reasons for corrosion damage and recommendations for remedial action. Utilisation of the Scanning Electron Microscope, X-ray diffractometer, Fourier transform infrared spectrometer microscope and inductively coupled plasma spectrometer allowed complete characterisation of corrosion products and underlying metals. Examples of corrosion work carried out during the year included exudate from concrete which was found to be attacking surrounding aluminium windows; pipe lagging which was found to be responsible for corrosion of hospital copper piping; flue gases corrosion; chloride-induced corrosion of electrowinning cells and steel filtration meshes; surgical instruments and metal gears; assessment of commercial rust convertors and inhibitors; assessment of coatings applied to pipes used in jetties and wharfs; and assessment of stainless steel for use underground and dye systems for security applications.

Artefact Identification

Work was undertaken for the Western Australian Museum using Fourier transform infrared spectroscopy to characterise elephant ivory. A selection of exhibits ranging from



walrus tusks to hornbill beaks were examined. The prime reason was to determine if FTIR could definitely identify elephant ivory and hence readily assess imported items and assist in the allocation of the correct tariff by Australian Customs Service.

Although FTIR could clearly differentiate between various bones, some teeth and all synthetic materials and ivory, it was not possible to determine the difference between ivory and some tusks, bone and front teeth. Nevertheless, together with other testing, FTIR proved to be a valuable instrument in characterising ivory. The work has led onto identification of ivory and previously used restoration products for the Fremantle Maritime Museum. In this work suspected ivory is collected from shipwrecks and from other collections and the authenticity and previous treatments are characterised.

Racing Chemistry Laboratory

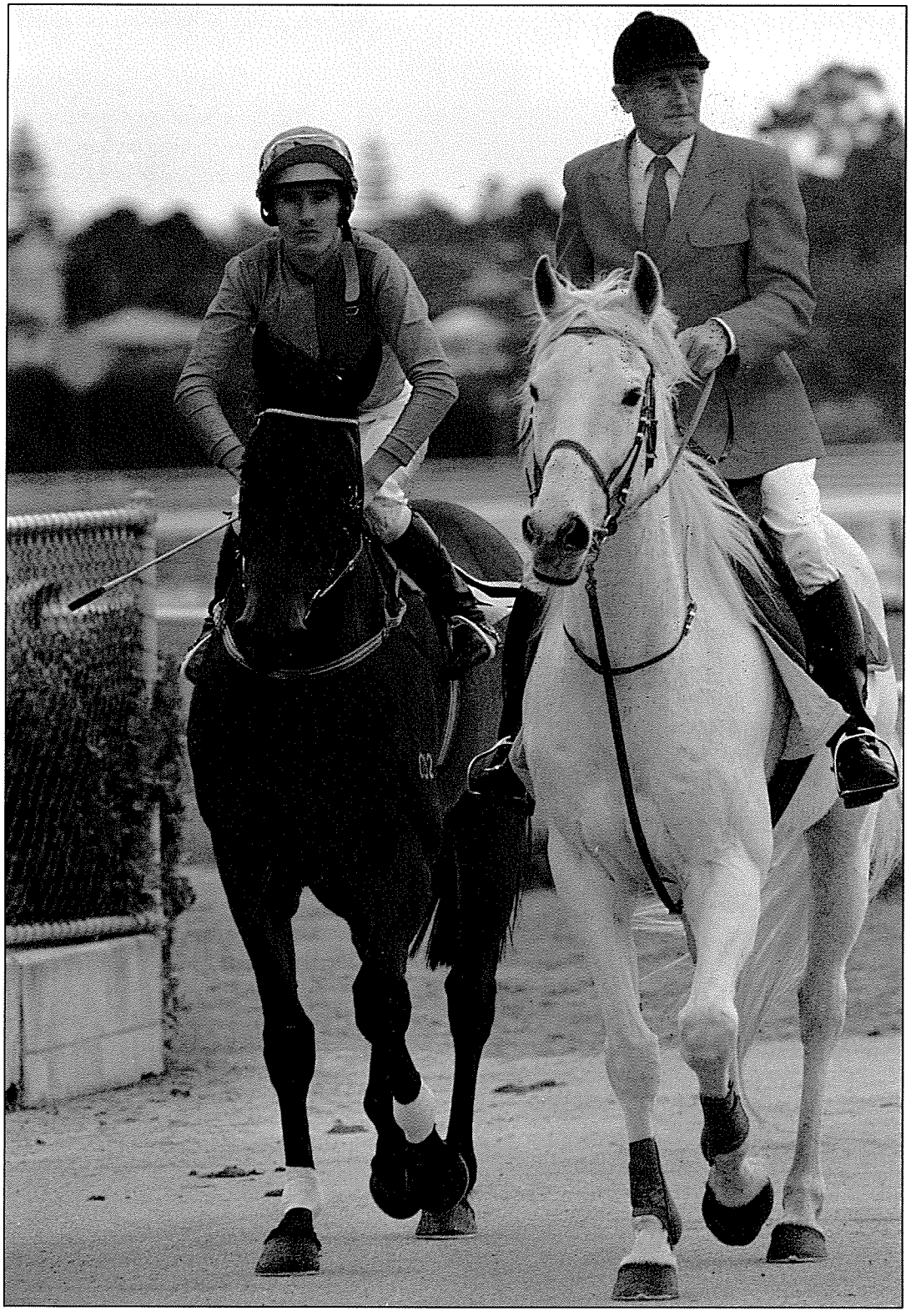
The Racing Chemistry Laboratory provides a drug monitoring service for the Western Australian Turf Club, Western Australian Trotting Association and the Western Australian Greyhound Racing Association. About 3 300 animals were tested during the year, a number which has remained fairly constant over the last three years. Urine samples are collected from horses. The success rate in obtaining these samples is about 75%. Blood samples are also taken and are analysed when no urine can be obtained, and also in cases of positive detections and certain other special circumstances. In the case of greyhounds, urines only are submitted to the Laboratory.

Eighteen positive detections were recorded involving 11 different drugs. The most frequently detected drugs were the anti-inflammatories (steroidal and non-steroidal) and the long time favourite stimulant caffeine.

An innovation this year was the testing of jockeys and reinspersons for drugs. This initiative by the Western Australian Trotting Association and the Western Australian Turf Club, which has resulted in four positive drug detections, has the support of the local industry and the initiative will be taken up by other racing clubs throughout Australia before the end of 1991.

A project was undertaken to examine the metabolism of some anabolic steroids in greyhounds. The work was carried out successfully by a student as part of her honours degree project, under the joint supervision of Allen Stenhouse, the Chief of the Racing Chemistry Laboratory and Dr John Knox, from the University of Western Australia. This was the groundwork established to enable the detection of anabolic steroids administration in greyhounds.

A new category of testing has been created on the NATA schedule to allow racing laboratories to be accredited. This initiative was to ensure the credibility of racing laboratories and ensure more uniform testing in Australia. The Racing Chemistry Laboratory has been required to document its protocols and methods in a format acceptable to NATA, and early in the next financial year it will be the first racing laboratory in Australia to be tested for accreditation.



Race horses like the one pictured left are drug tested on a regular basis. In fact, the Division's Racing Chemistry Laboratory tested 3 300 samples taken from race horses and greyhounds during the year.

Mining's Enormous Contribution to the WA Economy

"... in 1990-91 there were 10 mineral commodities produced with a value of production in excess of $100 million while five exceeded $500 million."

In 1891, 52 years after the founding of the Swan River settlement, the population of Western Australia was just below 50 000 people. Given the early promise shown by the State this low population level reflected just how difficult the process of colonisation had been.

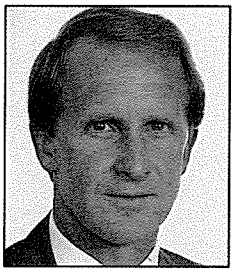
However, the discovery of payable gold in several places helped boost the State's population to 282 000 by 1911.

Towns established almost entirely to service the gold miners included Halls Creek, Marble Bar, Nullagine, Wiluna, Cue, Nannine, Black Range, Day Dawn, Mt Magnet, Menzies, Ularring, Leonora, Laverton, Lawlers, Niagara, Kanowna, Bulong, Kurnalpi, Broad Arrow, Coolgardie, Kalgoorlie and Norseman. The impetus created by gold resulted in the introduction of road, water and railway services to many parts of the WA hinterland.

With the slump of the gold industry between 1903 and 1930 many people turned to agriculture and other forms of primary production.

The period from the mid 1930s to the 1950s was relatively stable, with a slowly rising population and increasing rural exports. The only significant industry established was the Kwinana oil refinery while the State was a net 'loser' in interstate migration.

In the 1960s the mineral industry again became the major catalyst for growth. Commencing with the development of the huge Pilbara iron ore deposits other mineral developments followed with bauxite/alumina, nickel, oil and gas and heavy mineral sands.



Mr M (Murray) Meaton, BSc (Agric) Hons, BEc Director, Royalties and Policy Development Division

The Director of the Royalties and Policy Development Division, Mr Murray Meaton, said the value of mineral and petroleum production since 1961 had expanded by an average 20% per annum and was now $12.3 billion.

"The industry has become more diversified and in 1990-91 there were 10 mineral commodities produced with a value of production in excess of $100 million while five exceeded $500 million," he said.

Besides the enormous capital investment involved in mining, it also provides direct employment for more than 34 000 people in WA. Indirect benefits include:

- Employment generated in local industries as a result of the purchases of goods and services by the mining industry's own employees. (Employees earned almost $800 million in 1988-89).
- Employment generated in local industries supplying goods and services to the mining industry itself. (The value of such consumables in 1988-89 amounted to $2.3 billion).
- Employment generated in outside firms constructing new mines and providing them with plant and equipment. (The sum spent on new assets purchased by the mining industry in 1988-89 amounted to another $2.3 billion most of which was spent in the State.)
- Employment generated in downstream industries within WA.

Since 1964 eleven new towns have been developed primarily to service mineral and petroleum projects. The list includes Argyle, Goldsworthy, Dampier, Karratha, Wickham,

Newman, Paraburdoo, Tom Price, Pannawonica, Eneabba, Kambalda, and Leinster.

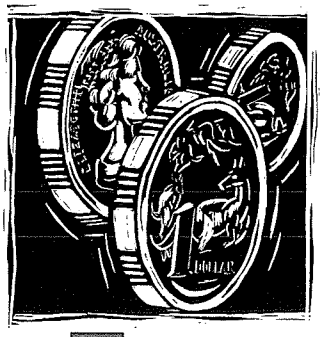
Virtually all these new towns have been supplied with power, water, roads, hospitals and schools by the mining companies. Other towns to benefit significantly from mining include Port Hedland, Kununurra, Kwinana, Mandurah, Bunbury, Pinjarra and all the towns in the Eastern Goldfields. The infrastructure list also includes four new ports and substantial additional export facilities at six ports (Wyndham, Carnarvon, Geraldton, Kwinana, Bunbury and Esperance).

Major railway facilities have been installed for four iron ore operations, while there is an extensive list of local recreational and cultural facilities developed by the industry.

Contrary to popular belief the mining and energy sector in WA is not simply an exporting quarry, but a very significant value added producer. While iron ore and salt are largely exported in their raw form, most other minerals undergo some form of processing. Gold is almost entirely sold as a refined metal, nickel is substantially refined into metal, and an increasing proportion of heavy mineral sands are sold in a highly concentrated or manufactured form. Diamonds are sold cleaned and sorted with the most valuable segment of production cut and polished in Perth, while petroleum is used in local refining and other processing. Bauxite is sold as alumina while base metals are exported as concentrates. Advanced processes developed as a direct consequence of mining in the State includes those for gold coins, jewellery, alumina (abrasives), zirconia (ceramics) and liquid air.

Mr Meaton said the mining and petroleum industries had paid $358 million to the State and Commonwealth Governments by way of royalty payments during 1990-91. A further $49 million was paid through the Department of Mines for special lease and tenement rentals and $6.4 million in charges for services or goods. It is estimated that the industry paid about $50 million in payroll tax while stamp duty probably exceeded $80 million.

Departmental Royalties Officer Kim Bowra (right) collects a cheque for $43 000, representing the first royalty payment on supergene copper from Worsley Alumina's Boddington gold operation.



ROYALTIES AND POLICY DEVELOPMENT DIVISION

THE YEAR IN REVIEW

INTRODUCTION

Highlights for the year in the royalties area included the collection and audit of a record level of royalties, finalization of new royalty provisions for iron ore, alumina and coal, and substantial progress towards resolving the backlog of outstanding petroleum royalty issues.

Despite a reduced staffing level in the policy area, the Division made a significant contribution to a Commonwealth/State Working Party on mineral royalty arrangements and prepared a large number of ministerial briefing papers and speeches.

Communications activities increased substantially during the year with over five major publications, more than 80 media releases, and four external displays.

More detailed notes on the Division's activities follow using the Department's Corporate Plan program and sub program headings.

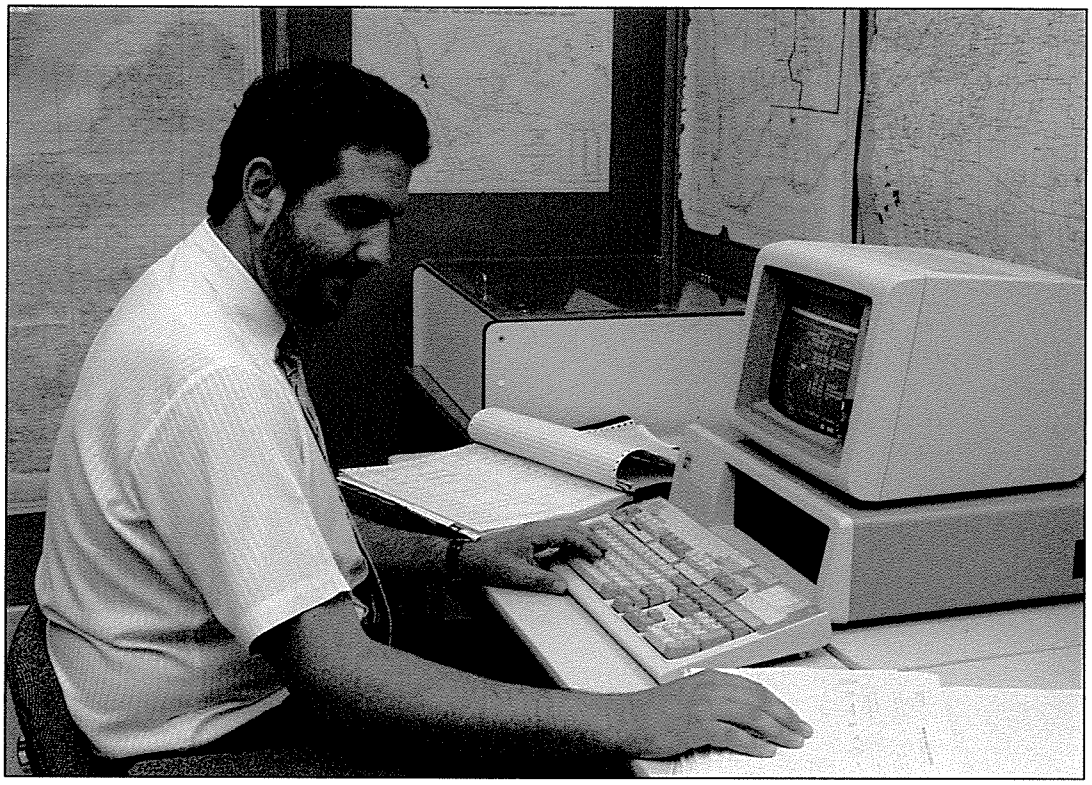
EXPLORATION AND DEVELOPMENT OF NATURAL RESOURCES

Community Relations

The Communications Branch with a full staffing complement of eight was able to complete a very comprehensive program of media releases, public relations, publications and displays. The Branch issued more than 80 media releases during the year and handled over 1 500 media enquiries.

Media visits were organised to sections of the Department and two media tours conducted to mining sites of special interest. The large amount of positive media coverage which resulted has almost certainly improved community understanding about the roles and responsibilities of the Department.

The Branch's desk-top publishing system operated well during the year and was used to produce last year's Annual Report and Annual Review to camera-ready stage. Two regular newsletters were also produced along with



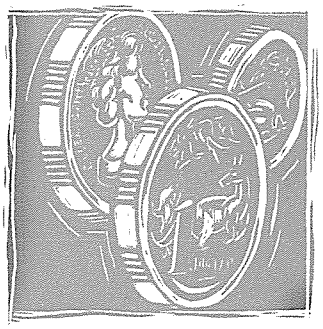
Statistics are an important part of the royalty collection process. Here Statistics Clerk Enzo Sisti keys-in production returns from a mining company.

three large publications and numerous brochures or pamphlets. The system has greatly improved the Department's ability to produce quality publications in a timely and economical manner. The Branch organized a very successful photographic competition which has now become an annual event. In addition to these activities the work of the Graphic Designers included four external and four internal displays. Work continued during the year on developing the Plain Street Museum with this facility being used by visiting school groups.

The Communications Branch played an active role in restoring a public service group within the Public Relations Institute of Australia hosting the inaugural meeting of the new group.

Policy Branch output during the year suffered from difficulties in recruiting qualified staff. The Branch was reliant on two experienced economists for most projects. Despite this, the Branch made a major contribution to a State/Commonwealth working party examining mineral royalties and handled a large volume of ministerial and executive briefing material. The evaluation of Foreign Investment Review Board applications continued with the development of more streamlined procedures to assist the process. Two Statistical Digests were produced during the year along with four Commodity Price Reviews. These documents provide valuable statistical information on mineral and petroleum production and are widely circulated to industry and Government.

During the year the Department's Communications Branch undertook considerable media relations work, like this media visit to Ampol's offshore oil rig near Rottnest Island, where Mines Minister Gordon Hill answered questions on important environmental issues.



ROYALTIES AND POLICY DEVELOPMENT DIVISION

THE YEAR IN REVIEW

Work commenced on development of a policy covering the flaring of gas from petroleum projects with work continuing on the development of a policy on the environment for the Department.

COMMUNITY BENEFITS

Including additional lease rentals from iron ore, mineral royalty payments for the year totalled $255.7 million. Iron ore payments represented over 60% of total collections, returning $154.6 million. Royalty collections from other minerals included alumina's 13% share, 11% from diamonds, 5% from mineral sands and 4% from nickel. All mineral royalties were retained by the State Government.

Collections from 1990-91 were $21 million or 9% higher than the previous year principally due to a $19.8 million increase in iron ore payments flowing from higher world prices. Receipts from alumina, diamonds and nickel were relatively unchanged,while a fall in mineral sands royalties was offset by increases from base metals.

The Royalties Branch finalized new arrangements for iron ore, coal and alumina during the year. Negotiations were also successful in resolving some issues of royalty interpretation concerning copper, manganese, bauxite and base metals. Work commenced on a review of specific rate royalties included in the Mining Act, with a planned finalization in 1991-92.

Total royalty payments made by petroleum projects based in Western Australia rose from $89.4 million in 1989-90 to $126 million in 1990-91 (an increase of 41%). The major factor underlying this increase was the continued growth of production. An additional boost to prices resulting from the Gulf crisis was a significant influencing factor.

Of the total payments made by petroleum projects in Western Australia, $92.4 million flowed to the State Consolidated Revenue Fund. After adjusting for shares from projects under State and Commonwealth jurisdictions, the State's net share of royalties was $65.5 million (up by 65%), while the Commonwealth share was $60.5 million (up by 21%).

The total value of petroleum production increased from $1.5 billion in 1989-90 to $2.6 billion in 1990-91. Crude oil output rose by 30% and condensate by 17% while their values increased by 75% and 57% respectively. Exports of LNG from the North West Shelf increased a massive 78% in volume and by 149% in value over 1989-90. LNG production will increase to a target of 6.8 million tonnes per annum in the mid 1990s which is more than double current shipments.

Discussions with petroleum companies continued throughout the year and Agreements on Airlie Island and Thevenard Island with Western Mining and WAPET, respectively, were substantially completed. In addition two royalty schedules, one for Tubridgi and another for Woodada were nearly finalized.

Resolution of a disagreement regarding royalties encompassing the Dongara pipeline was achieved while a very substantial backlog in petroleum royalty auditing work was reduced.

Development of a royalty verification manual for Barrow Island was completed while work advanced on manuals for other projects including the North West Shelf.

CORPORATE SERVICES

The Division operated at near full strength all year with the only difficulty being the recruitment of an experienced Policy Officer. A large volume of long service leave taken by staff during the year, at Government direction, limited output. However, 1991-92 should see much lower levels of staff absence.

Staff Training during the year concentrated on computer software and hardware with a

high level of computerisation now involved in nearly all divisional activities including royalty accounting and audit, economic modelling and the publication process.

A highlight of the year was the selection by the New Zealand Government of the Divisional Director to assist in a review of that country's mineral and petroleum royalty system.

Senior Royalties Officer David Norris (left) during an audit visit to Argyle Diamonds' West Perth headquarters.

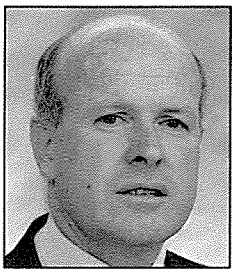
Age of the Paperless Office Looms

" We are completely satisfied with the CUPS system, and in many ways it has exceeded our expectations."

Are we witnessing the first signs of a "paperless office" within the Department of Mines?

Maybe!

Things certainly seem to be heading that way in the Management Services Branch, judging by recent events relating to the procurement of goods and services for the Department.



Mr K O (Kerry) O'Neil, MBA, CPA, Dip Pub Admin Director, Corporate Development Division

The move to do business via a computer terminal, rather than on paper, resulted from a decision by the Department of State Services to devolve some of its purchasing and supply functions to government agencies like the Department of Mines.

It began with the development of a piece of computer software known as CUPS — the Common Use Purchasing System.

Linked to a central Government computer, CUPS set out to short-circuit the process of requisitioning common-use items through the Department of State Services, with things such as office furniture, stationery supplies, industrial footwear and plain paper copying machines.

When the concept was first floated more than two years ago, the Department of Mines was chosen to trial the new system. However, a sudden urgency for its implementation saw the test period waived and the Department go live on the system in June 1989.

The perceived advantages of the new system — reduced ordering and delivery times and better prices — were soon confirmed by officers from our Management Services Branch.

Director of Corporate Development, Mr Kerry O'Neil, said that prior to CUPS it took up to 17 days for paperwork to be processed before goods were ordered. Delivery took longer.

"Now, orders can be literally raised one day and delivered the next," he said.

"We are completely satisfied with the CUPS system, and in many ways it has exceeded our expectations."

Mr O'Neil cited two incidents during the year that highlighted the value of CUPS.

The first involved the purchase of 25 transceivers as part of field communications for the Department's Geological Survey Division. Initial estimates put the cost of procuring the transceivers at around $75 000. However, the same product specifications were put to a range of other suppliers and the Department was able to purchase comparable items for just $55 000.

Our Management Services Branch secured another $20 000 saving by negotiating a new car servicing contract for the Mining Engineering Division. This resulted from a cross analysis of data extracted from the CUPS program which revealed the most competitive rates in the car servicing market.

Mr O'Neil said that apart from its obvious cost saving potential there were a lot of other intangible benefits associated with CUPS — things like the removal of frustrations associated with the old manual ordering system and new-found goodwill between ourselves and our suppliers.

To further streamline the purchasing process, an Accounts Payable module was added to the CUPS system in November 1990. It enabled the Department to speed up payments to suppliers and reduce the tedium of paperwork by divisional purchasing officers.

An adjunct to this, currently being developed by State Treasury, is a "Commitment System". In a nutshell, the system will allow government departments to automatically commit funds as soon as a purchasing order is raised. One feature is that organisations won't be able to overspend their budgets without special approval.

Another innovation was the introduction of the Corporate Credit Card in October 1990. Its main purpose is to replace Local Purchasing Orders (LPOs) which have been used traditionally for urgent minor purchases such as travelling expenses and non-standard office supplies.

The Department of Mines was one of the first government departments to use the corporate card. There are now about 230 of the cards in circulation among Mines Department employees throughout the State. All cards were issued on a needs basis rather than the rank of people concerned.

The plastic cards have again helped to reduce paperwork. Other benefits are that suppliers are paid promptly and fewer claims (particularly smaller claims) are lodged, mainly because employees' transactions are consolidated on a single monthly account.

But, perhaps the most powerful of all the new computer-based services relating to government purchasing is one called SUPPLYNET.

Based on Telecom's VIATEL service, it enables government departments to communicate vital commercial information to their suppliers. Typical information includes current tenders, standard (period) contracts, products available in the market place, forward procurement plans and quality assurance policies of each department.

The Department of Mines is also pioneering the development of electronic trading by transmitting orders to suppliers, on a trial basis, through SUPPLYNET. This will eventually eliminate the exchange of paperwork between the Department and its suppliers.

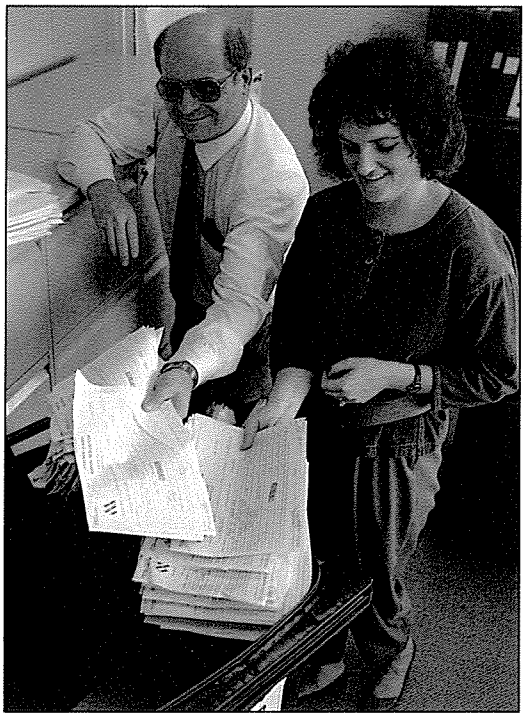
There are currently 110 suppliers and 15 government agencies using the SUPPLYNET service.

Like CUPS, the SUPPLYNET system is aimed at pin-pointing the best buying options available to government departments. In turn, suppliers have responded to the challenge by reducing prices.

It is estimated that the recent rationalisation of government purchasing systems is producing savings of about $15 million annually across the public service.

Added to that has been the elimination of literally tonnes of paperwork.

The Department of Mines' Manager of Management Services, Mr Joe Di Pietro, pointed to a bank of metal filing cabinets that once contained thousands of supply invoices and contracts. These cabinets will soon disappear from Joe's office — reminding us that the age of the paperless office is fast approaching.



Purchasing Officer Vanessa Moore lends a hand to the Department's Manager of Management Services Joe Di Pietro in the disposal of requisition forms which are now a thing of the past under the new computerised CUPS system.

CORPORATE DEVELOPMENT DIVISION

THE YEAR IN REVIEW

INTRODUCTION

Significant highlights within the Corporate Development Division included an increase of $61 million in Consolidated Revenue collections, a significant reduction in workers' compensation claims lodged and premiums paid, and the introduction of program management.

Access to information, communication and resources was also enhanced through the development and introduction of computerised systems (TENDEX, CUPS etc), and the commissioning of the new PABX telephone system.

At the same time, redeployment became a major issue with 40 staff being redeployed as a result of closure of the Drilling Branch.

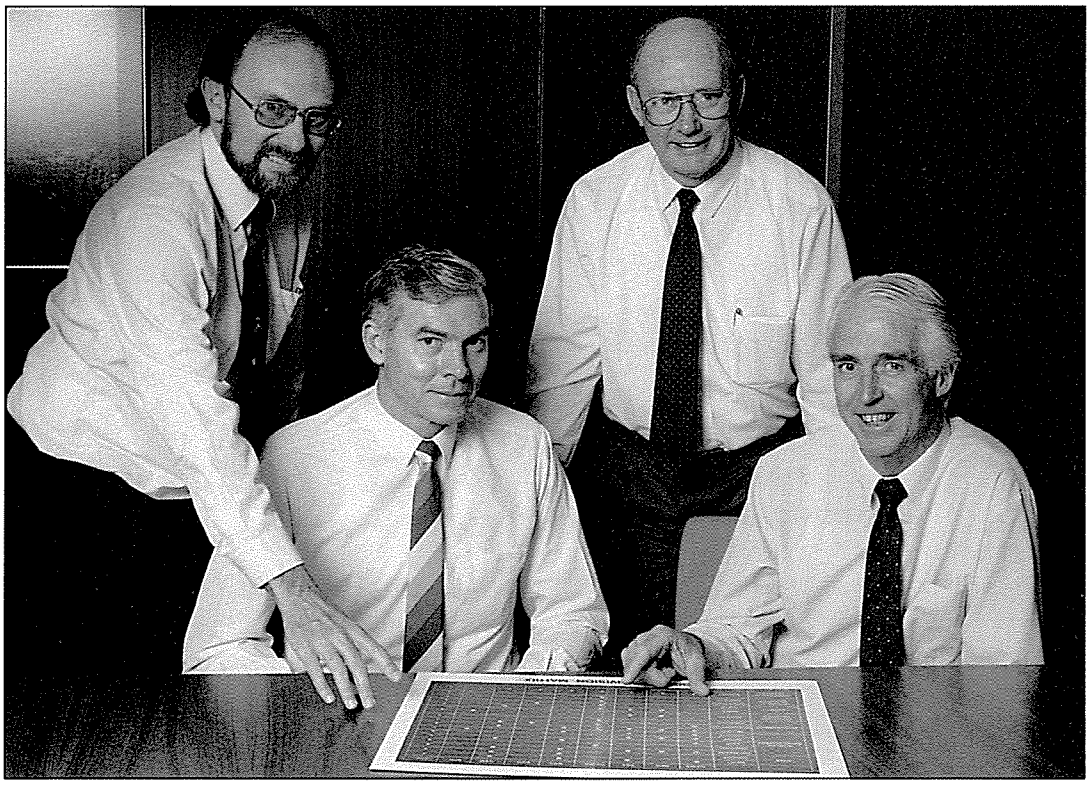
More detailed notes on these and other activities are presented below under headings relating to the Division's functional responsibilities.

Corporate Planning

The Department's commitment to corporate planning was continued during the year with the secondment of the Manager, Financial Services to the position of Corporate Planner.

With the introduction of program management into government, the Department has integrated the corporate planning and budgeting processes. The terms of reference for the appointment of the Manager, Financial Services as Corporate Planner was specifically prescribed as linking the philosophical view of organisational objectives as defined in the Corporate Plan into the budgeting and resources management processes of the Department.

During 1990-91 the planning framework designed towards the end of 1989-90 was refined and developed so that as far as possible the components of the departmental programs in the Corporate Plan represent cost centres



The Department's three program managers Dr Des Kelly (right), Dr Colin Branch (second from right) and Lee Ranford discuss the inter-relationship between programs and divisions with Corporate Planner Phil Palmer (left).

within the operating divisions of the organisation.

A new Operational Plan for 1991-92 was commenced to reflect the revised components of the Corporate Plan. This will form the basis of divisional quarterly reports to advise Program Managers of progress and actions to be taken in implementing the Corporate Plan.

Performance indicators were reviewed in 1990-91, and micro indicators of performance against desired outcomes now form part of the quarterly reporting process. Further work will be undertaken in 1991-92 on the redevelopment of broad indicators of program effectiveness.

Management Services

The Management Services Branch fulfils a range of functions including managing the supply of goods and services; project management, providing property services and developing and overseeing the implementation of the capital and minor works program.

Since assuming responsibility for its own procurement and disposal of goods and services in June 1989 the Department has been at the forefront of developing and implementing new government initiatives in this area. These initiatives include:

- the introduction of a Corporate Credit Card (Mastercard) to supplement the computerised purchasing system; and
- the implementation of the Supplynet system. (The Department has commenced a pilot study on electronic trading including sending orders electronically to selected suppliers.)

Management Services also carried out a number of reviews during the year designed to evaluate and improve performance. These included the review of the Chemistry Centre Library and the implementation of a computerised Asset Management Register.

In addition, a pilot study was undertaken of energy management within the Mineral House complex in conjunction with the Building Management Authority and outside consultants. The procedures implemented resulted in the complex achieving a saving of more than 10% in energy consumption.

Capital and Minor Works

During the year, significant expenditure from the General Loan and Capital Works Fund was directed at resolving occupational health, safety and welfare issues. Works undertaken were:

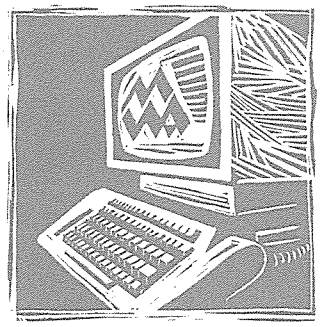
- 44 occupational health, safety and welfare projects within the Chemistry Centre - $248 294;
- alterations to the Agricultural Chemistry Laboratory - $119 733, of which $80 000 was privately funded;
- noise and dust abatement at the Kalgoorlie Metallurgical Laboratories - $53 643;
- assistance with planning the proposed Chemistry Centre complex, Bentley, and associated the CSIRO mineral research facility - $500 000;
- the Chemistry Centre's Material Science Laboratory upgrade - $273 000; and
- occupational health, welfare and safety minor works totalling - $43 000.

Information Systems

Computing

The impact of budget restrictions resulted in the deferment of some projects on information services. Nevertheless the enthusiasm and significant contribution of staff enabled the Department to develop some quality information systems for the divisions and industry.

The Department's usage of computer-based information systems has continued to increase. The 19 on-line systems now account for 19 000 transactions per day with the off-line reporting functions adding half as much again. The increasing load on the central computer is in line with the capacity plan which foreshadows the need to upgrade early in 1992-93.



CORPORATE DEVELOPMENT DIVISION

THE YEAR IN REVIEW

One of the features of the year's work was the enhancement and closer integration of information systems relating to mining tenements. The major visible change related to the introduction of graticular sections for exploration licences but supporting this initiative a considerable amount of work was done to bring TENDEX (the Mining Tenement Information System) and other associated systems into a coherent data structure.

Mining Registration Division is making steady progress towards the goal of an electronic register to replace the manual registers of mining titles maintained since 1894. A major step forward was the introduction of the on-line tenement rental and expenditure system, TRAXS which is basically a part of TENDEX; the two systems being closely tied by common tenement data. The system will reconcile rental demands and payments, will permit rent to be paid at any office and will issue notices. The last function will ensure that holders of the several thousand live tenements receive notification of rent due and a reconciliation of rent due and paid in previous years. It is anticipated that the system will ensure prompt and efficient collections of rents, thus increasing revenue, and provide better monitoring of the tenement expenditure conditions.

The Petroleum Exploration Index System (WAPEX), was further improved by linking the system to the Records Management System. WAPEX is an index to about 60 000 reports and 40 000 geophysical maps. The WAPEX-Records Management System link now enables the reports to be barcoded, their locations recorded and loans tracked. WAPEX is now an integral part of the daily operations of the Geological Survey Division's Basins and Fossil Fuels Branch.

The Department has continued to develop its resource-based information systems completing the Mineral Information System (MININFORM). Currently 2 400 sites are recorded of which 507 are operating mines. Details of resource information, and operating and exploration projects are maintained by the Geological Survey Division and are available for general interrogation through the Mineral Information Index System (MINEDEX). The third stage, completed but not yet implemented, is Mining Engineering Division's new Mining Operations System (MINEOPS). This system ensures that Mining Engineering maintains regulatory and inspection data on mining projects, sites, equipment and machinery.

Since August 1979 the Department has maintained computer-based data on atmospheric dust samples at mine sites. The new contaminant monitoring system, CONTAM2, completed in June 1991, is more extensive in scope and will contain data gathered since 1 July 1986. It is linked to MININFORM and MINEOPS to ensure consistency of data.

The Department has made significant progress in establishing a local area network (LAN) in Mineral House. Following trials within the Mining Engineering Division, Computer Services are now implementing a sophisticated LAN architecture within Mineral House. A central computer will be used for data storage and backup services for the network which will also be used by microcomputers to replace the existing Wordplex word processing network.

During the year computing staff assisted the Mining Registration and Surveys and Mapping Divisions to commence work on a system to display mining tenement boundary and associated relevent information on computer screens. This system, TENGRAPH, is the first development to use workstations to process data obtained from and maintained on the central computer within a single application framework. The development of such a

graphics-based system has far reaching implications for data handling and communications. Following the completion of the "user requirements study" work is continuing on prototype development and the specification of the system.

Finally the establishment of a new committee structure to set policy, approve planning, and to monitor and evaluate progress on projects will enable Computer Services Branch to continue to participate fully in the achievement of departmental goals.

Word Processing

Typing staff during the year have been busy with the section often under severe pressure. Emphasis has been placed on recruitment and personal development with an increased number of staff attending training courses to enhance quality of typing services.

The aging Wordplex equipment has proved difficult to maintain and within funding restrictions a graduated replacement plan is being implemented. The replacement plan using the new local area network (LAN) network and microcomputers will utilise standardised word processing software.

Records Management

One of the key initiatives undertaken in Records Management is the concept of "project files" whereby all information dealing with various aspects of a particular mining project is classified under the project title and files created in line with established protocols. During 1990-91, 95% of project files were converted to this new system, representing some 550 individual mining projects across the State.

Another major initiative being implemented to improve the Department's file classification system is the introduction of "structured file titling". Prime headings for each major subject category have now been established and further title structuring will be based on these prime headings.

This year saw a large increase in the microfilm program with 20 000 inactive files being filmed to make better use of storage areas.

Information technology continued to play a significant role in providing timely and effective services to the Department and industry. During the year further use of the computerised Records Management System (RMS) was made to improve information management by:

- establishing a database and barcoding facility for the "S-Series" Petroleum Reports; and
- providing a reporting facility on the current status of Ministerial correspondence.

Recognising the high standard of Information Management within the Department, our Records Manager was selected to establish and administer the complex records function for the present Royal Commission.

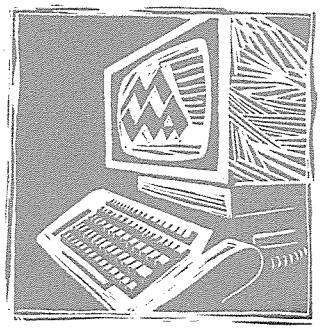
Telecommunication Services

The new Fujitsu 9600L PABX system commissioned in January 1990 is performing well and providing effective communications for the Department and its clientele.

The PABX serving the Exploration Safety and Drilling Branch, the Geological Survey laboratories and transport store at Carlisle was upgraded to provide direct indial facilities to users.

Continued monitoring of telephone usage through the computerised Telephone Information Management System has ensured effective and efficient use of PABX facilities and cost control.

The use of facsimiles as a means of communications continues to grow. During the year the Executive Division's and the Department's general facsimile machines were upgraded to plain paper laser printer units.



CORPORATE DEVELOPMENT DIVISION

THE YEAR IN REVIEW

The level of activity, user needs and technological advances will continue to be monitored to ensure that the Department is utilising this mode of communication effectively.

Financial Management

With the introduction of program management it has been necessary to link the budgeting and financial reporting processes of the Department with the Corporate Plan as outlined under the heading "Corporate Planning".

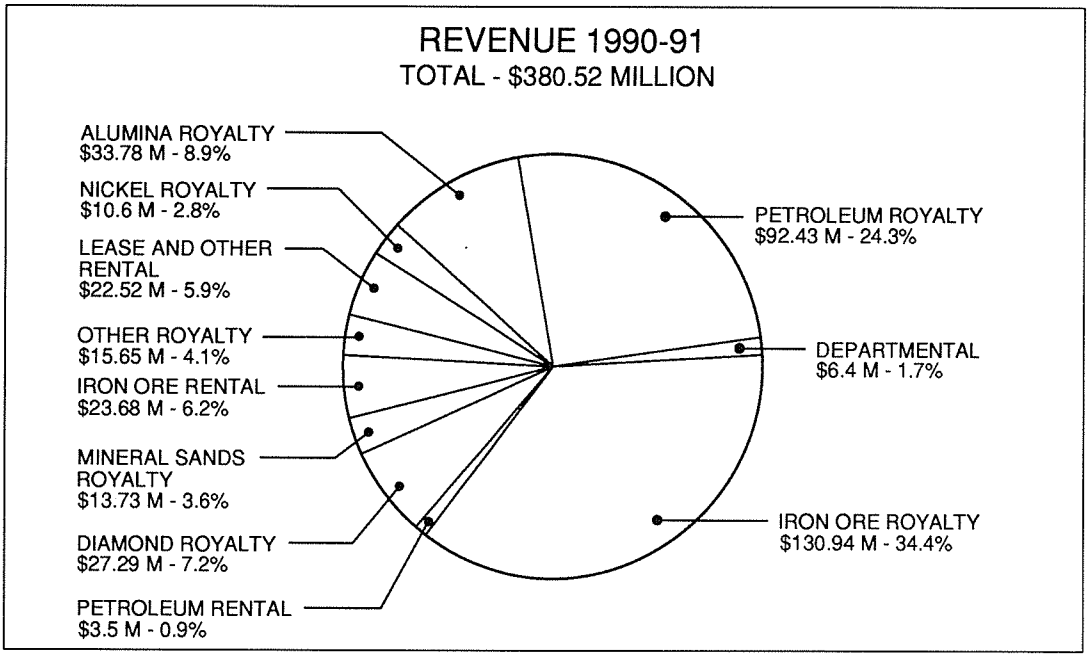
During 1990-91 the financial management information system underwent a major redevelopment to enable budgeting and financial management reporting to be conducted on both a program basis and a divisional basis. The monthly reports provided to management throughout the year have provided the following:

- a whole of Department matrix report to enable the Chief Executive Officer to view the finances of the seven programs and nine divisions of the organisation in one comprehensive statement;
- program reports to facilitate program management;
- divisional reports to facilitate divisional management by directors; and
- a series of lower level reports to facilitate cost centre management by branch and section managers.

The parliamentary appropriation of the budget was a "one line" appropriation for the first time in 1990-91. This gives the organsation greater flexibility to redetermine priorities and re-allocate funds throughout the year. The financial statements are therefore presented in program format for the first time this year.

Revenue

During the financial year the Department was responsible for the collection of $380.5 million through the Consolidated Revenue Fund (CRF), this being $61 million more than in 1989-90. Mineral and petroleum royalties collected from companies operating under State legislation comprised 85 per cent of this amount. Part of the revenue was also payments collected by the State on behalf of the Commonwealth for petroleum produced



within Commonwealth waters. These receipts subsequently were paid to the Commonwealth by way of special purpose payments after payment into CRF.

In addition to royalties, the Department collected lease and other rental charges and Departmental revenue. The latter, while considerably less as a proportion (1.7%), was still significant ($6.4 million) and represented charges for goods and services provided by the Department . The Departmental revenue largely originated from charges associated with the Registration, Explosives and Dangerous Goods Division and Chemistry Centre Divisions.

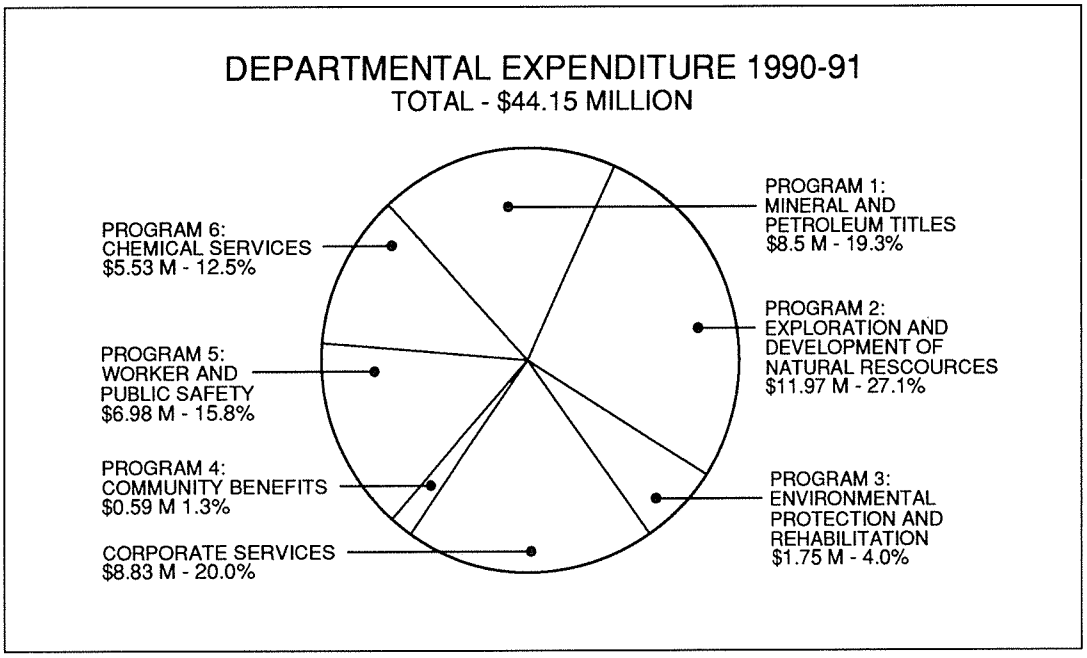
Expenditure

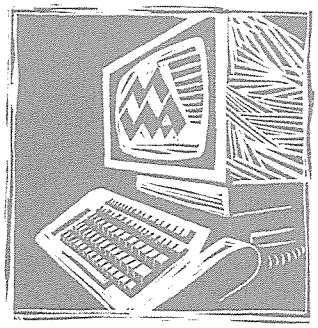
Funds are appropriated by the Parliament through the Consolidated Revenue Fund to provide for the operating costs of the Department. This appropriation includes provision for equipment replacement as well as refunds of revenue collected in previous financial years. It also includes expenditure which relates to activities of the mining and petroleum industries which are not operating costs of the Department. For example, costs associated with the Western Australian Coal Industry Council are included. This council provides a forum at which unions, coal mining companies and Government meet to gain a better understanding of industry needs. The payments, financed through the Consolidated Revenue Fund, are related to the seven programs undertaken by the Department.

During the financial year the Department's CRF expenditure budget of $42.228 million was overspent by $1.921 million (4.5%). This was as a result of under provision in the original assessment of the level of funding required for salaries, and a higher level of refunds of revenue collected in previous years relating to mining tenements which were either refused by the Department or the company deciding not to proceed.

Pricing Policy

The Department generally adopts a cost-recovery approach in determining fees and charges for services provided to the public and industry. With some services, where there is considered to be an element of "service to the





general public", a nominal fee has been determined. However, this represents only a small fraction of the service provided and has minimal impact on revenue.

To further refine and enhance the full cost recovery, user pays policy, the Department commenced a comprenhensive review of fees and charges. This will ensure that fees and charges are appropriate, and that where necessary, commercial cost accounting systems are developed and implemented during the 1990-1993 triennium.

A comprehensive review of the fees and charges levied by the Chemistry Centre was conducted during the year. The cost accounting framework developed the previous year was reviewed and redefined. In addition to charging for services provided to non-Government clients and Government trading concerns, a system of notional charging has been developed for services provided to Government agencies. This initiative is a precursor to charging for services provided to these agencies by the Chemistry Centre if the Government decides to implement such a procedure.

Human Resource Management

The Department reduced staffing levels as a result of restraints on recruitment and the closure of the Drilling Branch. This closure necessitated the redeployment of 40 officers either to other branches of the Department or to other Government agencies. The restrictions on recruitment also affected other human resource services and this resulted in redeployment and intensive training initiatives for personnel being the prominent staffing issues during the year.

In 1990-91 the Department's approved average staffing level (AASL) was 765.78 full time equivalents (FTEs), and the continued development of planning and monitoring strategies enabled the Department to operate effectively within this limit.

The rate of turnover fell by approximately 13% on the previous year with 137 staff resigning or retiring. However, restrictions on the filling of vacancies resulted in only 107 new staff being recruited.

Training initiatives continued to be intensive with over 752 staff attendances being recorded against a variety of management, development and technical courses, seminars and workshops during the year. Training expenditure for the year exceeded the one per cent required under the Training Guarantee Act, 1990.

A Training and Development Committee was established to: monitor needs common across divisions; develop training policies and procedures; and review departmental training programs.

Inter-active video and computer-based training programs were again well patronised, and enhanced through the purchase of further hardware.

In-house communication skills and posture education courses were provided for staff and these courses will form part of an annual program of training and development activities.

The proposed performance review system (PRS) system, for those divisions within the Department without formal systems, was circulated for comment. Acceptance and implementation of the PRS is expected to be completed during 1991-92.

Occupational health safety and welfare issues were addressed by implementing the following:

- rehabilitation programs for all staff following work related injuries;
- workplace assessments to ensure safe working conditions and environments;
- health education programs designed to prevent accident/injuries;
- confidential counselling service for work and personal issues that may impinge on staff productivity; and

- claims management for all workers compensation claims.

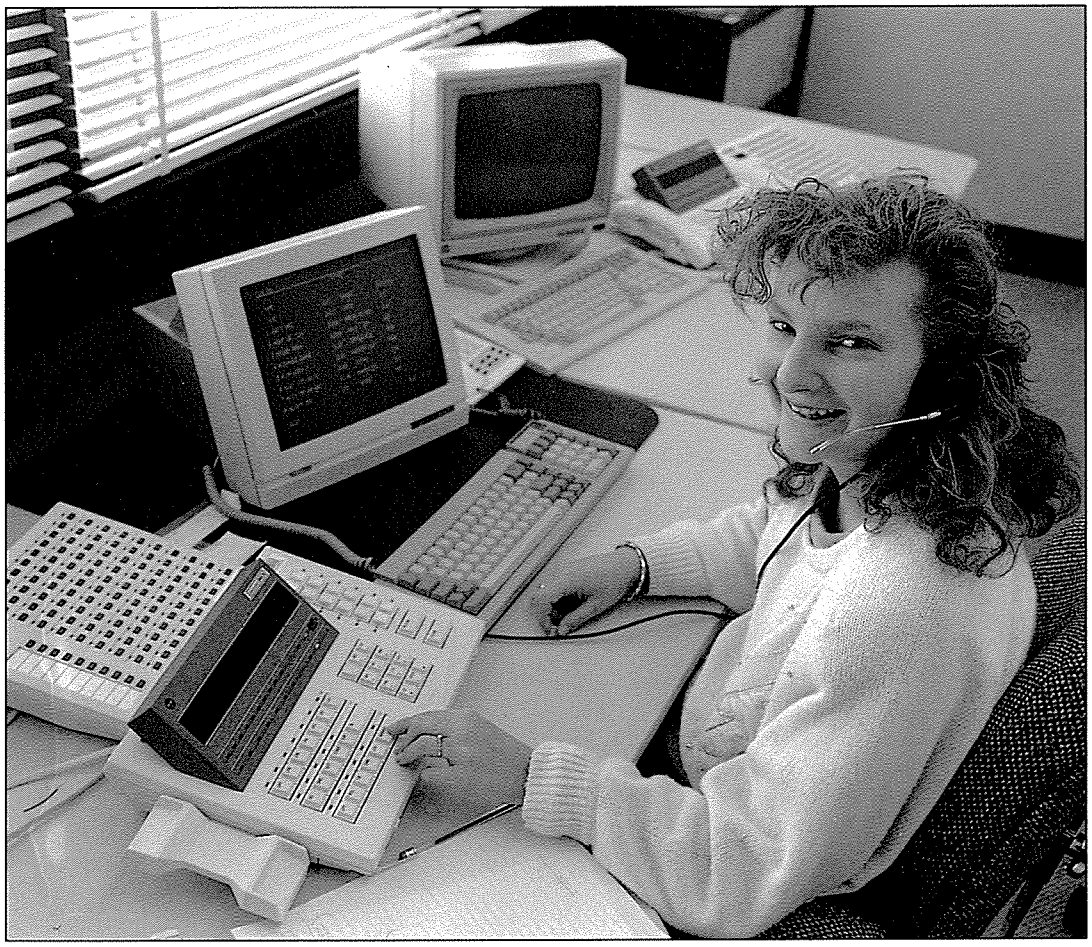
Initiatives in occupational health safety and welfare have resulted in a reduction in the Department's workers' compensation premium. During the year there were 39 workers' compensation claims of which 31 were accepted, four rejected, and the remaining four are still under consideration.

The current year's update of the equal employment opportunity management plan is being prepared and is due to be presented to the Directorate of Equal Opportunity in Public Employment in August 1991. The Department's last Annual Review was well received by the directorate.

Internal Audit

During the year, nine system based audits were carried out in accordance with the strategic audit plan. Audits were also conducted at seven of the Department's regional offices including the Kalgoorlie Metallurgical Laboratory. This coverage represented a significant cross section of the strategic audit plan for the 1990-91 financial year.

A review of the function and structure of the Internal Audit Branch was conducted by Management Services. The report recommended an increase in staffing levels for the Branch to achieve full audit coverage.



The demand for information related to mining can, in part, be gauged by the number of telephone calls received at the Department's head office. Some of the 450 000 in-coming calls recorded during 1990-91 were received by switchboard telephonist Karen Richardson (pictured left).

MINING ENGINEERING DIVISION

THE YEAR IN REVIEW

INTRODUCTION

The year saw substantial improvement in safety performance in the industry, with profound improvement in the underground metalliferous and coal sectors. However, this result has again been marred by a spate of fatal accidents in the latter half of 1990-91. In most cases, those who lost their lives were very experienced, and the type of accident was avoidable or preventable.

The Minister for Mines endorsed a study into fatal accidents over the last five to ten years to determine if more light may be shed on the underlying causative factors of these accidents.

Positive initiatives have continued to flow from the Inquiry into Safety in Underground Gold Mines.

The Mines Regulation Amendment Act was enacted and assented to in December 1990. Following consequential amendments to the Regulations, it is expected that it will be proclaimed during 1991-92.

Most operations in the mining industry have already moved to implement the consultative provisions of the Amendment Act.

Joint training courses for health and safety representatives commenced in November 1990 and are scheduled throughout the 1991 calendar year. These have been well attended and received. The courses were developed by the Chamber of Mines & Energy and the Australian Workers' Union and are being conducted by TAFE.

More detailed notes on the Mining Engineering Division's activities are presented below under the Department's program and sub-program headings.

EXPLORATION AND DEVELOPMENT OF NATURAL RESOURCES

Geological Data Collection

The Drilling Branch ceased to operate its prime drilling function on 8 October 1990. Prior to closing, the Branch successfully drilled 41 bores, totalling 2 154 metres and tested 16 bores on Rottnest Island. In a separate pump test program, the Branch administered contract drilling of 58 bores in the southern Perth Basin.

Over the last 40 years, the branch was involved in a diversified role of activities ranging from drought relief drilling, exploration of the State's water resources to land salination studies and groundwater pollution monitoring. The Branch's closure brought to the end an important chapter in the State's development.

To continue some of the Branch activities a newly formed Exploration Safety and Drilling Branch was created with the following objectives:

- to monitor and improve exploration safety ;
- to carry out safety inspections of mineral exploration drilling; and
- to let contracts for water resource assessment drilling and monitor drilling programs.

Geotechnical and Mining Engineering Advice

An extensive education program was instigated in conjunction with the Chamber of Mines & Energy to increase the industry awareness of potential problems caused by poor wall stability. Seminars were held on this subject throughout the State and resulted in the introduction of pitwall stability monitoring programs in a number of mines.

In July 1990, a computerised system for evaluating slope stability and rock support requirements was introduced for both underground and open cut operations. Since then, the system has been used extensively for evaluation of specific projects based on data collected during site inspections.

In addition, a comprehensive investigation into geological stability of underground operations has commenced. Findings from the

investigation will be compiled in an interim report due for release late in 1991.

Divisional publications, such as 'Minesafe', Significant Incident Reports and Safety Guidelines were prepared and distributed to the industry throughout the year. These publications proved to be a valuable asset for induction training, safety training and general education programs. In addition, a number of information pamphlets aimed at increasing miners' knowledge on a wide range of safety issues was published. The publications deal with such issues as the role of inspectors, accidents, record book entries, election of health and safety representatives, classified machinery, noise, chemical handling, radiation and electrical safety.

Community Relations

Western Australian Coal Industry Council

Considerable effort was devoted by the Western Australian Coal Industry Council to the viability of coal as a fuel for the State's next power station. As a result, a report was prepared by the council's standing committee showing potential for such a station at Collie. The report was actively promoted and presented to several key decision-making groups. It is widely considered that the report played a crucial role in the success of Collie's power station bid.

A council delegation visited the Eastern States to study specific topics such as underground coal mining technologies, practices, impact on local communities and other relevant matters. A report was prepared and distributed to the industry.

ENVIRONMENTAL PROTECTION AND REHABILITATION

The number of Notices of Intent submitted rose to 221 in 1990-91, an increase of 48% over the previous year. Eight Environmental Management Programs were received.

Proposals were reviewed for 110 new mining activities ranging from major production developments to exploration involving significant ground disturbance. Also, 111 proposals to expand or modify existing operations were reviewed.

Projects	New	Expansion	Total
Gold	81	81	162
Mineral Sands	11	2	13
Diamonds	1	5	6
Nickel	2	7	9
Manganese	3	-	3
Salt	1	3	4
Opals	1	-	1
Bauxite	1	-	1
Copper	1	-	1
Iron Ore	2	2	4
Gypsum	4	-	4
Silver	1	-	1
Others	1	11	18
Total	**110**	**111**	**221**

The figures above include six projects which were formally assessed by the Environmental Protection Authority.

The planning development committees in the Yilgarn and at Leonora continue to operate, while the informal group at Laverton meets once every six months. The committees have achieved their objective of encouraging liaison and co-operation between the mining industry and other land users/authorities.

Representation was maintained on Land Conservation District Committees throughout the pastoral zone.

A liaison group was established to guide the research work undertaken through the Department of Agriculture for a MERIWA project. The project's aim is to research the revegetation of mine waste dumps in arid regions of the State. Prolonged drought in the Murchison and Goldfields during 1990-91 helped prove that certain species could survive drought conditions even on such desolate terrain as mine waste. The research group is

based in Kalgoorlie and has research sites at Laverton, Leonora, Leinster and Mt Magnet.

Following production of the video 'A Stake in the Future', the Department of Mines, the Chamber of Mines & Energy, the Australian Mining Industry Council, EPA, and CALM funded a second video production titled, 'Making the Grade'. This latter video describes exploration techniques to ensure good environmental management.

Bonds to ensure an availability of funds for rehabilitation of minesites are now compulsory for all development proposals involving significant ground disturbance. At 30 June 1991 the Minister for Mines held 404 bonds, totalling $9 558 250.

During March 1991, the Chairman of the EPA and the Director General of Mines inspected operating and abandoned minesites in the Goldfields area. The principal objectives were to assess rehabilitation progress at minesites and liaise with local communities and authorities.

The Collie Coal Mines Rehabilitation Committee met on two occasions to consider criteria for rehabilitated mining land, hot ash disposal and water discharge licences. Triennial environmental reports were issued by the companies and used for reference on rehabilitation work.

The Golden Mile Mining Development Planning Committee continued to operate. A study into the social impact of open pit mining proposals at Kalgoorlie-Boulder was conducted and noise and pit wall stability investigations initiated.

WORKER AND PUBLIC SAFETY

Workers' Safety and Health

Mine Safety Legislation

The Mines Regulation Amendment Act No 85 of 1990, incorporating general duty of care provisions and the requirements for health and safety representatives and committees, passed through the Parliament on 22 December 1990. Proclamation of the Act will take place once necessary amendments to the regulations are completed.

The Mines Regulation Amendment Regulations 1991 were gazetted on 15 February 1991. These regulations amended Part 9 of the Mines Regulation Act Regulations to provide for protection of mine employees against noise-induced hearing losses.

The Mines Regulation Act, Regulation 2.7 was repealed on 15 March 1991 abolishing the District Inspectors of Mines Selection Committee.

The Coal Mines Amendment Regulations 1991, Regulation 21 was amended on 21 June 1991 to increase the fee for management certificates.

The Coal Mines Bill is completed in draft form and the writing of coal mining regulations is proceeding.

Inspections

Mining operations were regularly inspected to ensure that they are complying with the Mines Regulation Act and Regulations and that work is being conducted in a safe manner.

Greater emphasis was placed on underground mine rescue procedures in mines operating diesel powered equipment. A policy was instigated requiring all underground mines operating such equipment to establish a mines rescue team or have access to other teams within close proximity of operation.

Mines inspectors actively promoted procedures for adoption during mine rescue and recovery operations.

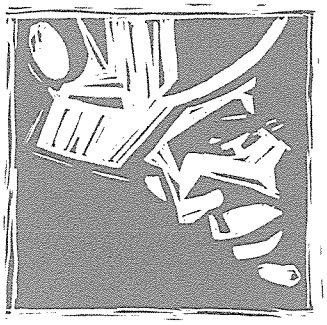
A number of mine rescue teams were established throughout the State. New volunteers also underwent first aid and rescue apparatus courses in several locations before becoming formal mines rescue teams.

In a separate task aimed at minimising fire outbreaks in underground mines, the requirement for installation of fire fighting

SUMMARY OF MINE CLOSURES AND EQUIPMENT SHUTDOWNS 1990-91

		Surface		Underground	
	Inspectorate	**Safety Reasons**	**Following Accident**	**Safety Reasons**	**Following Accident**
Number of items of equipment stood down:	Perth	61	3	11	-
	Kalgoorlie	49	5	17	4
	Karratha	33	5	3	2
	Total:	**143**	**13**	**31**	**6**
Number of occasions portion of mine closed:	Kalgoorlie	47	5	59	8
	Karratha	20	3	9	1
	Total:	89	**8**	**100**	**9**

Preparedness is a key to mine safety. Here, mine workers hone their response skills during the annual mines rescue competition in Kalgoorlie.



equipment on heavy haulage underground vehicles was upgraded. The requirement now stipulates a fixed fire suppression system using AFFF foam to be fitted to all new vehicles, and existing vehicles are required to comply with the standard before 1 July 1992.

Throughout the year, the allocation of safe refuge chambers in underground mines was promoted to ensure adequate fresh air is supplied to miners in emergency situations.

Continual support and assistance was provided to all inspectorates by specialists from the Research & Technical Services Branch of Mining Engineering Division. In particular, support was provided in the following areas:

- emergency preparedness and procedures;
- investigation of underground mine fires;
- policy and advice on mine ventilation;
- policy and advice on diesel equipment emission control devices;
- policy for the introduction of fixed fire suppression systems on underground diesel vehicles;
- liaison with mine equipment suppliers on safety and health issues, modifications or manual corrections;
- preparation of manuals for inspectors;
- reporting on the product of combustion should certain plastics used underground be involved in fire;
- management of computerised recording systems such as AXTAT and CONTAM.

Where necessary, the information and assistance provided, was sourced from agencies such as Worksafe Australia, universities, suppliers, mining companies, government and research organisations.

Closure of sections of plants or parts of mines and the 'grounding' of items of defective equipment was considered to be the most immediate and effective remedial action for non-compliance with relevant regulations in some instances. A total of 193 items of faulty equipment were stood down by inspectors, while partial mine closures totalled 206.

The table at the head of the next page provides a detailed breakdown of these events in each inspectorate for the year:

Mechanical - Structural

A substantial increase in assessment of new designs and modification/repair proposals related to classified machinery was recorded during the year with more than 150 submissions approved. A further 19 'approved persons' were designated to carry out inspections of classified machinery on mines. There are now a total of 44 'approved persons'.

A major review of Part 6 of the Mines Regulation Act, Regulations dealing with machinery in mines was undertaken to ensure conformity with regulations applicable to industry generally. These amendments are due for proclamation late in 1991.

A total of six fixed headframes, two transportable headframes, two tripods, two hoists, two winders and 13 shaft conveyances were approved.

Railways

Robe River Iron Associates continued with driver-only operations for ore trains on their main line. These operations are now conducted on a contract basis by the same workforce which was previously employed by the company.

Approval was given to BHP Iron Ore Newman Operations for the provisional use of new operating rules for a period of 18 months commencing in September 1991.

The need for standardisation with the Newman operations, prompted BHP Iron Ore - Goldsworthy to undertake a review of their railway rules.

Fifty seven locomotive engine drivers certificates of competency were issued during the year.

MINING ENGINEERING DIVISION

THE YEAR IN REVIEW

Electrical

Special Inspectors of Mines (Electricity) carried out 1 111 inspections at 509 mining locations during the year and submitted 566 notifications of electrical defects to registered managers. The level of inspection activity represents an 18.8% increase when compared with 1989-90 and is 34.8% higher than in the 1988-89 year.

Notwithstanding inspectorial activities, the number of reported electrical accidents increased by 50% to 113. Regrettably, one fatal electric shock occurred which resulted from damage to a buried electric cable during excavation of a leaking water main. Analysis of statistics reveals that more accidents are caused by unsafe work practices than by defective equipment.

A total of 222 submissions relating to approvals, exemptions and appointments were processed and six prosecution/warnings were issued for the carrying out of unlicensed or unauthorised electrical work.

Occupational Health

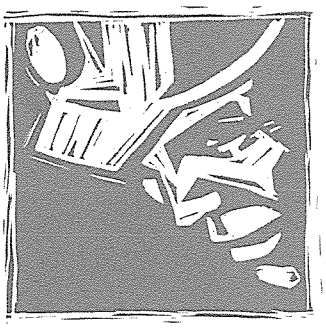
Occupational health matters received a high level of attention during the year. Regular inspections and field projects were carried out and the range of activities included:

- atmospheric contaminant measurement and control;
- occupational noise and blast monitoring;
- chemical handling and management; and
- radiation safety.

Work continued on research projects and completed projects included:

- development and subsequent review of dust control action plans for the mineral sands industry;
- investigation into the hazard of exposure to amorphous silica fume associated with a silicon smelter;
- development of asbestos management programs for mining and processing operations;
- investigation into mercury vapour exposure in gold tailings retreatment plants;

Special Inspector of Mines Jerry Wilczewski checking noise emission levels from a mining company's processing plant.



- development of guidelines for noise control in mines; and
- investigation into blast noise and vibration arising from large open cut operations at Kalgoorlie.

Elevated levels of mercury vapour in gold tailings retreatment plants were also investigated and excessive absorption of mercury by some gold room operators was identified as a result of the routine biomedical surveillance program. The exposure was attributed to the treatment of old tailings contaminated with mercury. Remedial action was introduced at the affected plants and workplace guidelines were provided to alert industry to the potential risk of mercury vapour exposure.

A discussion paper was prepared outlining a number of recommendations and regulatory initiatives which should be introduced to enhance the medical surveillance of mine workers. A modified and enhanced medical surveillance system is considered necessary to reflect current occupational hygiene conditions in the industry.

As a result of much discussion about exposure to amorphous silica fume, a study was commissioned to critically review relevant scientific data on health effects associated with occupational exposure to this by-product. The study confirmed that the exposure standard established by the Mines Ventilation Board was health protective.

A protocol for asbestos management has been developed in the Department to limit the risk of workers' exposure to airborne fibres. Key elements of the protocol include:

- regular monitoring and surveillance of mining areas suspected to be contaminated with asbestiform minerals;
- delineation of areas containing asbestos and access control;
- limiting exposure to airborne fibre through primary emphasis on dust suppression, isolation of workers and dust containment, secondary emphasis in personal protective equipment;
- consultation, instruction, training and supervision;
- personal hygiene practices; and
- disposal procedures for fibrous waste materials.

Occupational Noise

The inclusion of occupational noise regulations into Part 9 of the Mines Regulation Act, Regulations, became effective on 15 February 1991.

These regulations aim to minimise the risk of noise induced hearing loss by mineworkers.

A set of approved procedures was subsequently gazetted to provide detailed information on methods used to ensure compliance with the regulations.

Mines inspectors reviewed and assessed the noise control measures implemented by industry. Considerable time was devoted by inspectors to assisting in the conduct of noise officers' courses organised throughout the State.

Chemicals Handling and Management

A considerable number of chemical inspections was carried out at mineral processing plants throughout the State during the year. Attention was given to the bulk storage of incompatible chemicals, cyanide storage, and the provision and maintenance of safety showers.

Guidelines were prepared for the safe handling and storage of cyanides, corrosives, flotation chemicals, hydrogen peroxide, and heavy metal salts such as lead and mercury.

Practices and operating conditions were assessed at most process plants, and action taken to ensure compliance with safety standards in the handling of bulk chemicals on minesites.

Comprehensive reports on each plant were prepared highlighting potential hazards from

equipment, chemicals and their degradation products.

Chemistry Centre officers assisted in chemical inspections of several laboratories and stores in the Kalgoorlie Inspectorate.

Radiation Safety

A ministerial review had recommended investigation into the level of radiation exposure encountered by mineral sands workers. Subsequently, the Minister for Mines commissioned an audit team of three radiation safety experts outside WA to examine and report on a wide range of radiation health and safety practices in the mineral sands industry.

The Technical Audit Team (TAT) report was published in September 1990. The TAT Report provides a comprehensive analysis of radiation safety in the mineral sands industry. The report found that current industry radiation safety practices are satisfactory and confirmed that the reduction of radioactive dust levels in the mineral sands processing plants remains the principal concern. The report acknowledged that actual radiation doses received by workers may be less than the reported figures because of uncertainty arising from the internationally-recommended assessment procedure and the effect of respiratory protection. In summary, the TAT concluded that regulatory surveillance by the Department of Mines was very effective.

The Radiation Section continued its involvement in inspection and enforcement tasks. In addition, the technical secretariat function to the tripartite Mines Radiation Safety Board was also provided. Six meetings of the Board were held and site visits to the Chandala Dry Plant, AMC's operations at Capel and ISK's Waroona and Picton operations were undertaken.

Ventilation

A total of 271 new permits for underground use of diesel engines were issued during 1990-91. Thirty six permits were issued in Karratha Inspectorate; 166 in Kalgoorlie and 69 in Perth.

The increasing use of large diesel equipment underground prompted further scrutiny of the efficiency of ventilation systems in mines. A major advance was made in reducing diesel emissions by changing to exhaust gas treatment by use of catalytic converters and soot filters which burn off a large portion of the respirable particulates in the exhaust as well as converting aldehydes to less harmful compounds.

A program of testing ventilation fans was instigated during the year. So far the fans tested produced expected airflows.

A number of variations were made in atmospheric contaminant sampling quotas to reflect changes in the mining operations.

The continuing excellent support by industry in sending people to Departmental courses in ventilation is ensuring that requirements of Part 8 and 14 of the Regulations are being met.

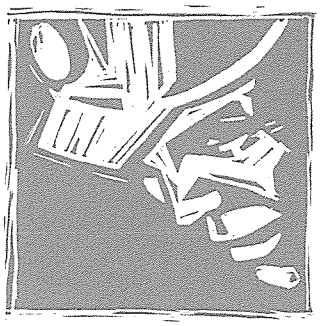
Five meetings of the tripartite Ventilation Board, established under the Mines Regulation Act were held during the year. The Board visited sites at Argyle, Telfer, Cadjebut, Mt Newman and Dampier to observe and discuss specific matters relating to ventilation and atmospheric contaminant controls.

The Mines Medical Officer reported the following data from the Perth Chest Clinic:

- 5 324 new applicants for miners health certificates (down 27% on the previous year);
- 2 603 re-examinations; and
- 4 new cases of silicosis identified at re-examination.

Contam

The CONTAM database, which holds the results of analysis of atmospheric contaminants, had more than 30 000 sample results added during the year. Results were



reviewed by the Ventilation Board to assess exposure to gases, fumes and dust by mine employees.

Implementation of the revised CONTAM system was carried out during the year.

It is anticipated that the revised CONTAM will be fully operational by September 1991. The main advantage of the new system is its simplicity, flexibility of operation and trend reporting.

Axtat

The computer-based AXTAT system which systematically records vital information relating to accidents in the State's mining industry entered its fifth year of operation.

The report, 'Fatal and Lost Time Injuries in Western Australian Mines' which is published every six months also provided an important statistical breakdown of all lost-time injuries. Furthermore, a publication titled 'Western Australian Mines - Occupational Injuries - 1990 Calendar Year' was published for wide circulation among the workforce.

Geotechnical Investigations

Following increased seismic events in the Eastern Goldfields which led to extensive damage in the Fimiston underground operations, a technical working group was established to examine the question of seismicity in Western Australian mines.

The role of the working group is to address the following:

- methods of improving the accuracy of the current seismic monitoring system;
- the design and, if necessary, installation of suitable monitoring systems to record seismic activity;
- the origin of seismic activity and its relationship to mining activity;
- the formulation of strategies for the design of underground mines subjected to seismic risk; and
- the preparation of guidelines on operating procedures such as ground support for underground mines subject to seismic risk.

Education and Training Initiatives

Four ventilation officers' courses were conducted during this year with 77 people attending. The courses were designed for surface and underground staff and presented by Departmental officers.

The Minesafe International Conference held in Perth between 10-14 September 1990 was attended by staff who also contributed papers and a poster display to the conference.

Geotechnical officers conducted a series of lectures and seminars on open pitwall stability in a number of country locations.

Senior officers presented seminars on the implications of the Mines Regulation Amendment Act 1990 and the new noise regulations. The seminars were held in conjunction with the Chamber of Mines & Energy in a number of major mining centres throughout the year.

The Minister for Mines launched a publication titled 'Guidelines on Safety Bund Walls Around Abandoned Open Pits'. The publication was prepared following an extensive consultative process with the industry. The guidelines set out acceptable standards for the safe abandonment of open pits achievable at reasonable cost. They have been of considerable assistance to the industry.

Fatal Accidents

There were 10 fatalities in the mining industry for the year, all in metalliferous mines. Details of the fatalities are included in the statistical summary.

Prosecutions

There were 14 prosecutions (comprising a total of 204 individual charges) for offences against the Mines Regulation Act during the year ended 30 June 1991. These are detailed in the statistical summary.

MINING ENGINEERING DIVISION

THE YEAR IN REVIEW

Board of Examiners - Coal

The Board of Examiners (Coal) met four times during 1990-91 and issued six Certificates of Competency, including one First Class Mine Manager, three Third-Class Deputies and two Opencut Mine Managers.

Board of Examiners - Metalliferous

The Board of Examiners (Metalliferous) met five times during the year, twice in Kalgoorlie (First Class and Underground Supervisors) and three times in Perth (Quarry Managers).

A total of 692 candidates sat for examinations during 1990-91, but not all had been assessed at the end of June.

During the year the boards issued the following Certificates of Competency:

- First Class — 18
- Underground Supervisors — 57
- Quarry Managers — 23
- Restricted Quarry Managers — 56

Mine Survey Board

The board met twice during 1990-91 and 15 Authorised Mine Surveyor's Certificates were issued.

Additional details relevant to the certificates issued by the various boards are incorporated in the statistical summary.

CORPORATE SERVICES

Staff

Personnel changes within the Mining Engineering Division during the year included six resignations and nine new appointments.

A great deal of effort was expended by the executive in attempting to fill vacancies for staff, in particular, district mining engineers and a number of critical positions, including a mechanical engineer for the Kalgoorlie Inspectorate.

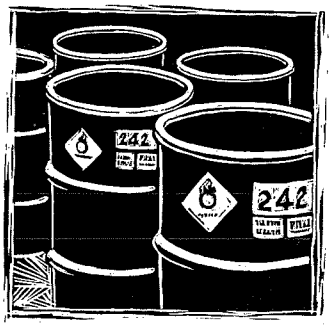
The restructuring of the Research and Technical Services Branch was completed, but limitations on staff numbers in the Department prevented all positions being filled. Recruiting difficulties were experienced in specialised areas such as geotechnical, mining and occupational health.

Restructuring of the environmental responsibilities in the division was considerably more successful, resulting in full staffing with well-qualified, experienced personnel.

Following the closure of the Drilling Branch, 40 officers (22 wages and 18 salaried officers) were redeployed within the Department or with other public sector agencies. At 30 June 1991, 37 of these officers had been effectively redeployed including 13 to other agencies.

The Assistant Director - Drilling, four of his Drilling Supervisors and a secretary/typist have been retained within the Division's newly formed Exploration Safety and Drilling Branch.

At the end of 1990-91 year, 97 staff were employed in the Mining Engineering Division.

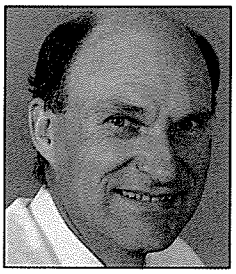


New Dangerous Goods Regulations Coming Soon

" Our consultation with key interest groups such as the chemical industry, fire brigades union and other government departments was extremely thorough."

New regulations covering all aspects of dangerous goods storage and road transport are on the threshold of being introduced.

After a development phase spanning five years, the Parliamentary Draftsman is due to release his final draft of the regulations shortly. And, provided no unforeseen problems emerge, the new regulations could become law by the end of 1991.



Mr K R (Ken) Price BSc (Hons), Grad Dip Admin, ARACI Director, Explosives and Dangerous Goods Division

The new regulations are the product of consultation between industry unions and government.

The catalyst for change was a proposal back in March 1986 to introduce a new code of practice covering liquefied petroleum gas (LPG).

This was deferred when the then Ministers for Minerals and Energy; and Labour, Productivity and Employment saw the need to take a broader look at the handling of hazardous substances within the community. Gaps were identified in aspects of public safety relating to goods such as cyanide, chlorine, LP gas, ammonium nitrate, pool chemicals, calcium carbide and sulphur.

Furthermore, the Government recognised the need:

- for industry to be given greater flexibility in deciding the best range of safety options for their particular operation;
- to minimise unnecessary intrusions by Government, including the promotion of systems audits rather than inflexible prescriptive regulations; and
- for the new regulations to be consistent with national standards and codes of practice.

The Public Safety Sub-Committee took up the challenge. It succeeded in drawing up instructions for the Parliamentary draftsman covering the specific matters identified by government (cyanide, chlorine and LPG) as well as general problems associated with a wide variety of other dangerous goods.

The first draft of the regulations was circulated widely for public comment and then rewritten in the light of those comments.

The regulations are consistent with Australian Standards. They also follow the international trend away from prescriptive details, preferring instead to give industry the flexibility to take advantage of new technologies. At the same time, industry assumes responsibility for its changes.

The Public Safety Sub-Committee saw little point in having comprehensive regulations to control flammable liquids if, for example, there were no supplementary requirements controlling incompatible dangerous goods which might be right next door.

To manage that problem the sub-committee recommended that general requirements be drafted covering safety matters such as:

- segregation between incompatible dangerous goods;
- separation between dangerous goods stores and buildings on adjacent properties;
- placarding and warning signs; and
- emergency response planning and training.

The emergency response planning section is a key part of the regulations because it gives authority to various emergency response groups to be involved in the planning process. These requirements have particular importance in the Kwinana area where they supplement the hazard control plans being developed by

major hazards industries and the Kwinana Industry Emergency Management System.

Director of the Explosives and Dangerous Goods Division, Mr Ken Price, said no short cuts had been taken in getting the regulations to their present final draft stage.

"Our consultation with key interest groups such as the chemical industry, fire brigades union and other government departments was extremely thorough," he said.

"But, like most things, there will be an implementation process with its inevitable teething problems which we will experience after the new regulations are introduced either later this year or sometime in 1992."

Mr Price added: "It took us (industry and the Department) about five years before we felt comfortable with the Dangerous Goods (Road Transport) Regulations, and we are still refining them.

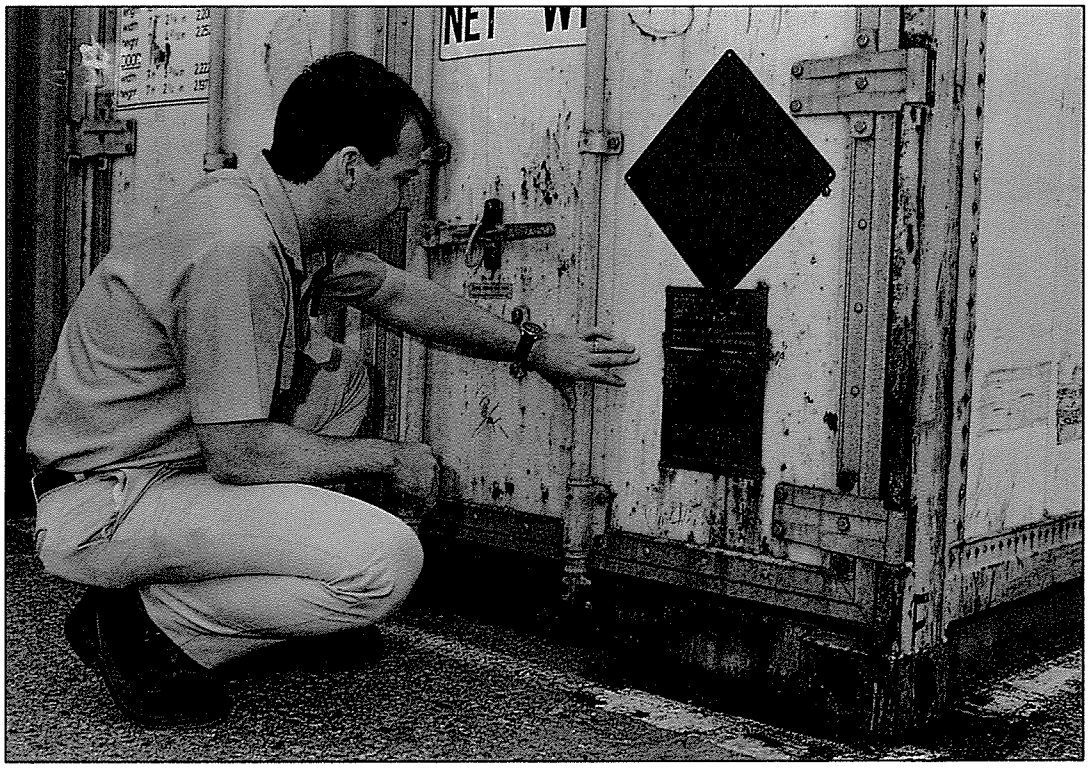
"I don't expect that the comprehensive new set of regulations will be any easier.

"We will be looking for co-operation and patience from industry during the bedding-in process."

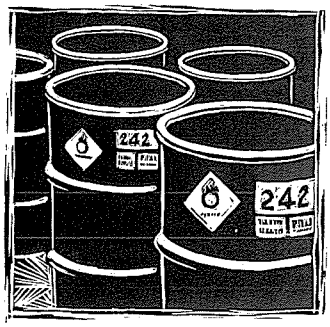
And, a final note on the transport of dangerous goods.

The introduction of the new combined regulations will see the formal introduction into Western Australia of the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code) and the corresponding demise of the Dangerous Goods (Road Transport) Regulations.

When introduced in 1983, Western Australia's transport regulations were ahead of the rest of the nation. They filled gaps which existed in the ADG Code because of its early stage of development at that time. The ADG Code is now a comprehensive national standard and Western Australian industry has been working to it for some time. It is appropriate to now phase out the WA regulations in favour of the national code.



Divisional inspector Richard Bilman inspects an imported freight container of dangerous goods for the currency of international approvals prior to distribution from the Fremantle Port Authority.



EXPLOSIVES AND DANGEROUS GOODS DIVISION

THE YEAR IN REVIEW

INTRODUCTION

During the year many initiatives were progressed for the proposed implementation of the new Dangerous Goods Regulations in 1992.

After close scrutiny and without compromising public safety in respect to the storage, handling and transport of dangerous goods, some of the time-consuming activities were devolved to private industry.

More detailed notes on the Explosives and Dangerous Goods Division's activities are presented below using the Department's Corporate Plan program and sub-program headings.

ENVIRONMENTAL PROTECTION AND REHABILITATION

The Explosives and Dangerous Goods Division is a decision-making authority in accordance with provisions of the Environmental Protection Act and is required to refer proposals for the storage of dangerous goods to the EPA for assessment prior to indicating approval.

To overcome the difficulty of dealing with large numbers of applications, a referrals liaison system was implemented between officers of the Division and the EPA's Industrial Assessments Branch. Meetings acted as a 'filtering' process whereby minor storage applications not requiring formal assessment by the EPA were cleared for processing immediately and significant proposals were deferred pending implementation of the EPA's assessment scheme.

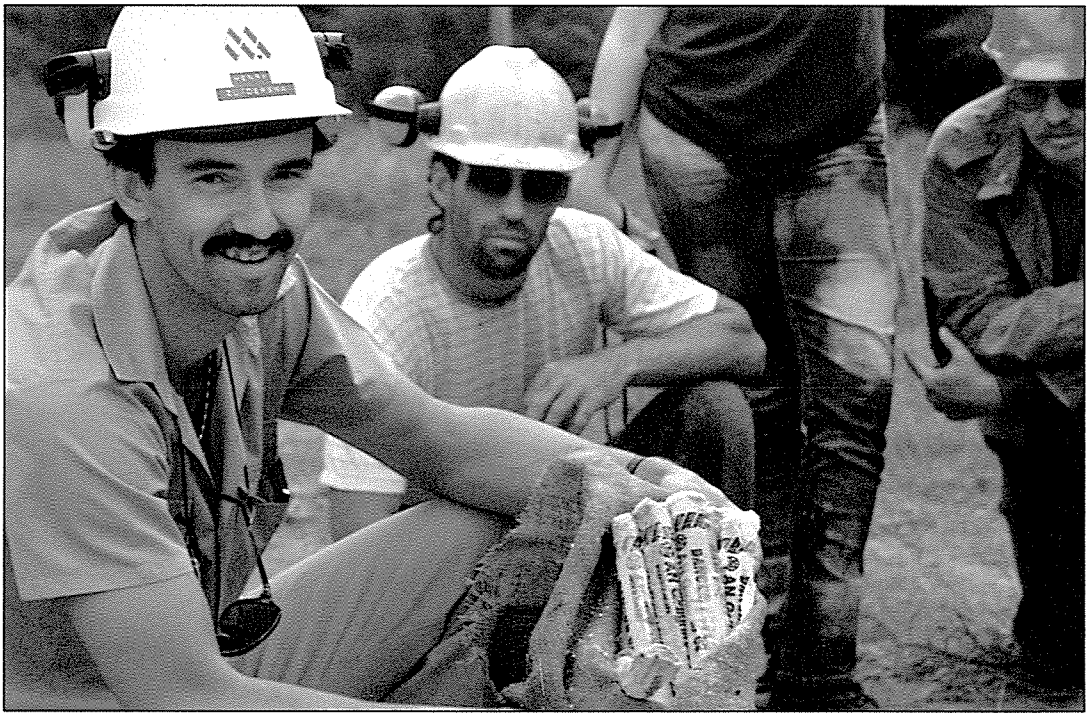
WORKER AND PUBLIC SAFETY

Management of Dangerous Goods

Accidents

During the year 41 accidents were reported; 24 related to the transport of dangerous goods, 12 to the storage of dangerous goods and five to activities associated with explosives.

The most significant incidents during the year emanated from major storage and



Explosives Inspector Henry Zuidersma provides instruction on the safe disposal of deteriorated gelignite at a shotfirer's course conducted during the year.

handling sites. They included a 131 000 litre spill of flammable liquids at the BP refinery, an 80 000 kg release of methane from the Burrup LPG plant and an 18 000 litre petrol spill from a fuel depot at Northam. Two of these incidents were caused by operator error and the other to equipment failure.

Vehicle Routing

A Working Party set up in 1989 to examine the feasibility of prescribing routes for dangerous goods vehicles continued to meet during 1990-91. The Working Party, which is chaired by a representative of the Mines Department, is finalising its report to the Western Australian Advisory Committee on Hazardous Substances (WAACHS).

Protection of the State's important water assets, bounded by the Moore River in the north, the Murray River system in the south and the river catchment areas of the Darling Scarp, became the focus of concern to the Working Party.

Detailed maps of the region identifying rivers, lakes, streams and wetlands have been prepared and overlaid on a heirarchial roads system as the basis of a geographical information system of the area.

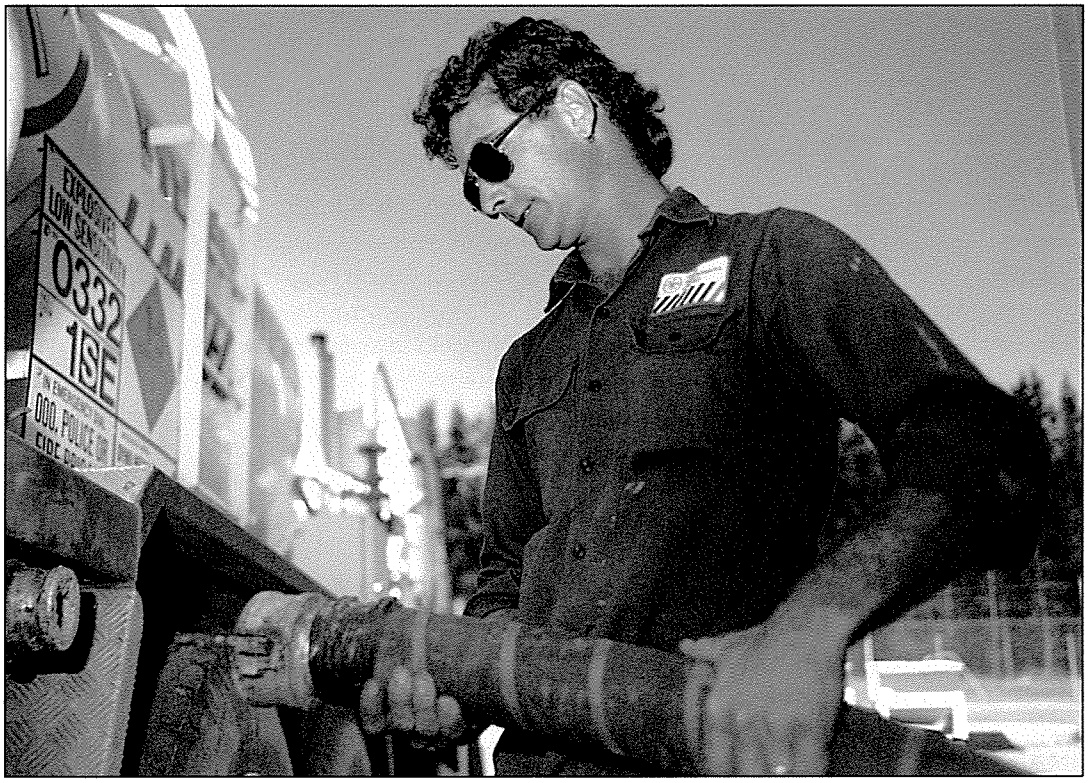
The final report of the Working Party should be forwarded to WAACHS during the last quarter of 1991.

Rail Transport

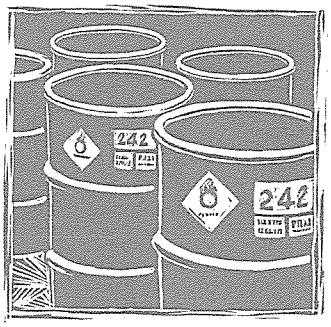
Representatives monitored and reported on Westrail's self-imposed audit of its dangerous goods operations in 1991. The audit team conducted interviews with Westrail personnel and carried out on-site reviews of operations at Kewdale, Forrestfield and West Kalgoorlie. It is yet to deliver its final report.

Third Party Accreditation

A new operational format with the accreditation of third party organisations to conduct testing of bulk containers for dangerous goods was introduced during the year. In the past, inspectors supervised pressure



An employee at Dyno Wesfarmers Ltd loading up an explosives emulsion truck at the company's Baldivis explosives reserve.



tests, some taking up to four hours to complete. This was seen as an inefficient use of resources. Accreditation has involved the auditing of written procedures, operational techniques and equipment by inspectors. Successful companies are required to submit test reports on bulk containers for electronic recording. They will also be subjected to formal and random audits.

Australian Explosives Code

The Australian Explosives Code, which specifies requirements for the packaging, labelling and transport of explosives, was published in May 1991. Prepared by a special working party reporting to the Advisory Committee on the Transport of Dangerous Goods by Road and Rail, the code is the basis of uniform legislation governing the transport of explosives in all States.

Among other things, the code will require vehicles to be designed so that explosives are conveyed in locked compartments. This is a significant change over requirements of the current Explosives Regulations which have applied to the transport of explosives since 1963.

Explosives Reserves

An extensive review of security at the Kalgoorlie Explosives Reserve was undertaken following vandalism at a bulk manufacturing facility in February 1991. The review identified areas where security could be improved. Recommendations of the review are currently being implemented.

The Kalgoorlie Explosives Reserve was expanded with the acquisition of a 5 000 square metre portion of the safety zone. Extra land was required to enable the company, ERT Explosives, to construct an explosives manufacturing plant. The ERT facility was scheduled to be in production in August 1991.

Shotfirer Training

Negotiations are being held with training institutions such as TAFE and IFAP to takeover the long-established shotfirer training courses. This action stems from demands on Mines Department staff to complete a growing range of other important tasks.

Major Hazards — Ammonium Nitrate

The import and storage of ammonium nitrate featured prominently in the Division's activities during 1990-91.

Two shipments, each of 2 000 tonnes, were received at the Port of Esperance. A further shipment was partly received at Port Walcott and then diverted to Dampier when a cyclone interrupted unloading operations.

Numerous containerised shipments were received at Kwinana and Fremantle during the year.

Safety proposals put forward by the relevant port authorities for the proposed importation of ammonium nitrate through the ports of Esperance, Dampier and Geraldton were assessed during the year.

Comprehensive emergency response plans are being developed and tested for both Esperance and Dampier, and it is likely these will be the favoured ports for future imports.

Kemerton Industrial Parklands

The Kemerton Advisory Board appointed a risk assessment consultant to work with the Department of Mines to identify the extent of the buffer zone required for the proposed industrial area at Kemerton, north of Bunbury.

The Department has developed an integrated mathematical model of the Kemerton area, which has been used to define the extent of the buffer zone, based upon the predicted industrial use of the parklands.

As developments are approved, the risk model will be updated to ensure that public safety standards are maintained.

Woodside Offshore Petroleum's LNG Plant

Woodside's performance in applying its Hazards Control Plan has been audited by Shell International Petroleum Maatschappij (SIPM). The SIPM audit team, consisting of eight

experts drawn from around the world, spent 10 days undertaking the audit.

They concluded that:

- "the safety message had reached the total workforce and was understood by them;
- good progress had been made with the implementation of the Hazards Control Plan; and the maintenance of plant integrity was generally well controlled."

Tiwest Pigment Plant

A Hazards Control Plan has been prepared for the Tiwest plant at Kwinana and audited by a third party working to terms of reference prepared by the Department of Mines. The auditor found the plan to be an appropriate technical standard capable of meeting the principles of self-managed public safety requirements. The challenge for the coming year will be to advise and assist Tiwest in the application of their plan.

Liquid Air Oxygen Plant

A simple Hazards Control Plan has been prepared by Liquid Air for their plant at Kwinana. This has been audited by officers of the Department and accepted as being appropriate for the location and hazards involved.

Wesfarmers LPG Plant

Wesfarmers' Hazards Control Plan, which includes a detailed structural and geotechnical assessment of the large refrigerated storage tanks on the site, has been prepared and audited. The audit identified a number of actions that the company should take to improve public safety. Current operation of the plant was found to be safer than the levels initially reported to the EPA. The Hazards Control Plan will be implemented next year and subject to an annual external audit of compliance.

Nufarm Chlorine Plants

Nufarm have prepared a Hazards Control Plan for their Kwinana plant. The plan has been audited by a third party auditor and accepted by the Department of Mines. During the coming year the plan will be implemented and revised to ensure that optimum techniques are used to maintain public safety. As soon as the plan is fully implemented on the Kwinana site the company will be required to implement a similar plan at their Kemerton site under Section 45C of the Explosives and Dangerous Goods Act.

SCM Pigment Plan

The Hazards Control Plan for SCM's Kemerton site has been audited by a third party auditor. The auditor made recommendations for an improved safety performance by the company. SCM gave a commitment to implement these improvements, and, on that basis, the Chief Inspector has accepted the company's Hazards Control Plan.

Kwinana Nitrogen Company

A Hazards Control Plan has been prepared for the import of ammonia via the bulk cargo jetty and the storage of up to 30 000 tonnes of ammonia in a fully-refrigerated, double-integrity API 620 storage tank. The Hazards Control Plan has been audited, and current methods of maintaining public safety have been found acceptable by the Chief Inspector.

Fremantle Port Authority

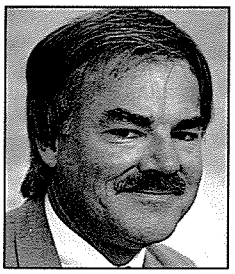
A consequence analysis has been prepared on the request of the Environmental Protection Authority for the operations of the Fremantle Port Authority and associated industries. The study was conducted to evaluate the possible impact of these operations on public safety. Also considered in the analysis were the safety infrastructure needs to allow safe development of the port's operations.

New Graticular Boundary System for Tenements

"... mineral explorers could now apply for up to 70 graticular blocks, certain in the knowledge that the area they had applied for was accurately defined."

After more than five years of investigation and development, the Department of Mines' "graticular boundary system" for exploration tenements came into force on 28 June 1991.

Only time will determine the effectiveness of the system. However, feedback from the mineral exploration industry even before its implementation was positive which augers well for its long-term acceptance.



Mr W (Bill) Phillips, Dip Pub Admin Director, Mining Registration Division

Indeed, the response from seminars held in Perth and Kalgoorlie to explain the new system was excellent, with more than 230 people attending in Perth and about 40 at a follow-up gathering in Kalgoorlie.

The system, based on pre-determined lines of latitude and longitude known as graticules, is a refinement of successful systems that have been operating in New South Wales and Queensland for several years.

Western Australia, which is bigger than the combined areas of Queensland and New South Wales, has been divided up into 1.4 million blocks or "graticular sections".

Each graticular section is one minute by one minute in size, or approximately 280 hectares. When linked to one of 20 Map Sheet names throughout the State and given a sub-divided reference number (for example, "Kalgoorlie 1467N"), the area specified has a unique identity.

The Department of Mines' Director of Mining Registration, Mr Bill Phillips, said mineral explorers could now apply for up to 70 graticular sections, certain in the knowledge that the area they had applied for was accurately defined.

"The same could not be said for old methods used to describe the boundaries of exploration licences," Mr Phillips said.

"A problem of the past was that what appeared on a map (the various public plans) was not always a true reflection of what ground the applicant was seeking.

"I can recall the classical case of the 'Try Again Bore incident', north west of Leonora, where a mineral company used a water bore as a reference point to describe the location of an Exploration Licence.

"The case ended up in the Supreme Court when a dispute arose over some highly prospective exploration ground in the vicinity of Try Again Bore."

A subsequent investigation revealed a discrepancy of some 300 metres in what was shown on the map and where the water bore actually appeared on the ground.

It was apparent that the pastoralist had several years earlier re-positioned the bore after it had dried up.

Mr Phillips said nothing like that could ever happen with the Department's new graticular boundary system.

"What you see on the map is what you get. Lines of longitude and latitude will not change," he said.

Other advantages of the graticular boundary system are:

- no gaps or overlaps with other Exploration Licences;
- simple descriptions of applications, surrenders etc. and the opportunity for an error-free record.
- greater security of tenure; and

- its integration with offshore mining and petroleum legislation.

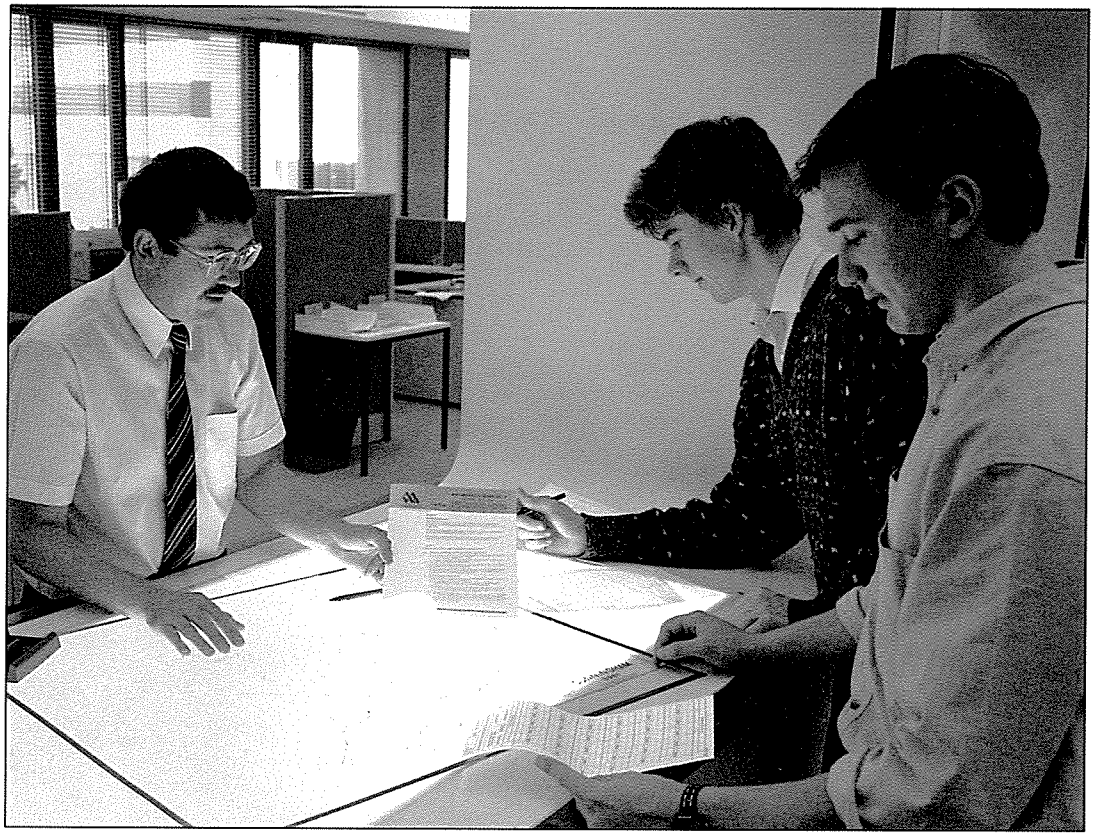
Actually, the petroleum industry has been successfully using larger-scale (five minute by five minute) graticular systems to define tenement boundaries for many years.

Mr Phillips said smaller traditional mining tenements such as Prospecting Licences and Mining Leases would still have to be marked out on the ground.

"However, with the growing popularity of portable global positioning systems (GPS), it is probably the first step towards eliminating ground marking (with pegs and trenches) for all exploration-type mining tenements," he said.

These new-generation GPS systems can pinpoint locations within fine tolerances and they virtually remove the risk of any mistakes being made.

The technology was used with good effect by US pilots and troops during its recent desert conflict with Iraq. The cost of these hand-held GPS systems is coming down all the time, and according to Mr Phillips it is only a matter of time before they became a common item in the kit of mineral explorers, be they individual prospectors or field personnel backed by mineral exploration companies.



An acting manager in the Mining Registration Division Neil Spencer (left) explains the graticular boundary system to customers visiting the Department's head office public counter in East Perth.

MINING REGISTRATION DIVISION

THE YEAR IN REVIEW

INTRODUCTION

A review of staffing requirements of the Mining Registration Division was conducted during the year. Because of the downturn in some title related functions it was possible to reduce staff numbers in Head Office by 5% without affecting the level of customer service. The staffing of outstation offices is still under consideration by Government.

The year ended with the introduction of a number of significant changes affecting the title registration system. These included:

- a new system of graticular boundaries for exploration licences;
- reduced fees for tenement applicants with the commencement of the "user pays" surveys system; and
- a package of various other amendments to the Mining Act.

Tenement transactions began to pick up late in the year and the Division appears set for a busy year ahead.

More detailed notes on the Mining Registration Division's activities are presented below using the Department's program and sub-program headings.

MINERAL TITLES

Title Systems

Tenement Applications

During the year a total of 4 989 applications for mining titles were received.

A comparison of applications received in recent years is shown below:

	1987-88	1988-89	1989-90	1990-91
Prospecting Licence	5 361	3 367	2 426	2 720
Exploration Licence	1 671	1 420	1 451	1 285
Mining Lease	1 838	1 243	998	695
Other	406	367	201	289
Total	**9 267**	**6 397**	**5 076**	**4 989**

There were 14 847 mining titles in force as at 30 June 1991. The total area of the State held under mining titles was 20 472 186 hectares.

Fluctuation in the number of mining titles in force over the last three years has largely been linked to prospecting licences, with numbers reducing 54% from 11 919 on 30 June 1989 to 5 517 on 30 June 1991. The total of all other

Mining Registrars from throughout the State gathered in Perth during the year to be briefed on the introduction of graticular exploration licences.

existing titles fell 4% from 9 773 to 9 330 in the same period.

In November 1990 the Government released its "Resolution of Conflict — A Clear Policy for National Parks". Work subsequently commenced to determine a number of long outstanding applications in respect of National Parks and Conservation reserves.

Prospecting Licence Extensions

A total of 1 034 extension applications were received during the year. This represents a decrease of 37% on applications lodged during 1989-90.

Dealings

There were 14 620 dealings received during the year.

Tenement Surveillance

The number of applications for exemption dropped to 2 744 after the all-time high of over 3 300 in 1989-90.

The 9 580 Form 5 reports lodged reflected the drop in the number of titles in force.

A total of 962 mining tenements were forfeited for non-payment of rental or breach of condition.

Departmental officers were involved in the investigation of eight cases of illegal or unauthorised mining and proceedings were commenced in respect of five of these.

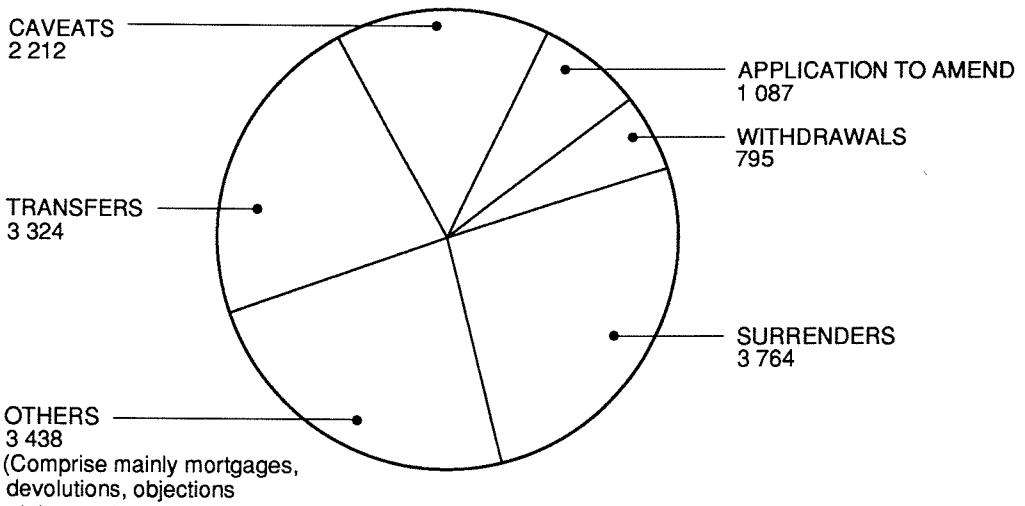
Customer Service

Work levels at the Mining Information Centre at Head Office remained high. On a daily basis throughout the year an average of 80 customers were served and 64 plan orders received. Throughout the year, 23 281 mining tenement register searches were provided.

The separate telephone centre facility set up in 1989 to deal with general tenement enquiries and receive plan and publication orders remained an integral part of customer service. An average of 79 calls per day were dealt with.

MINING TENEMENT DEALINGS 1990-91

TOTAL DEALINGS 14 620



MINING REGISTRATION DIVISION

THE YEAR IN REVIEW

Dispute Management

It was possible in almost all cases to have objections and disputes heard within three months.

Warden's Court facilities were upgraded by the supply of Lanier recording equipment in the Leonora, Coolgardie, Meekatharra, Mt Magnet, Marble Bar and Norseman courthouses.

Review of Fees and Charges

Application fees, Warden's Court fees and various dealings charges were reviewed. An increase of 7% in all these charges was implemented on 1 July 1990. Tenement rentals were previously increased on the 1 May 1990.

CORPORATE SERVICES

During the year, a total of 92 staff were employed in the Division, 58 in Head Office and 34 at country centres.

A Mining Registrars' Conference, and staff seminars were held to familiarise staff with the new graticular system introduced for exploration licences, and various other amendments made to the Mining Act.

A number of field visits were organised for staff to give them an appreciation of the operational side of exploration and mining, and an understanding of rehabilitation techniques used by industry.

Training courses attended by staff included computer education and a seminar dealing with investigation techniques.

During the year the Division held an exposition of its functions and activities for the benefit of other departmental employees. The exercise helped enhance the spirit of cooperation that exists with other divisions in carrying out common objectives.

The Department operates 12 mining registrar's offices throughout the State, including the Mt Magnet office.

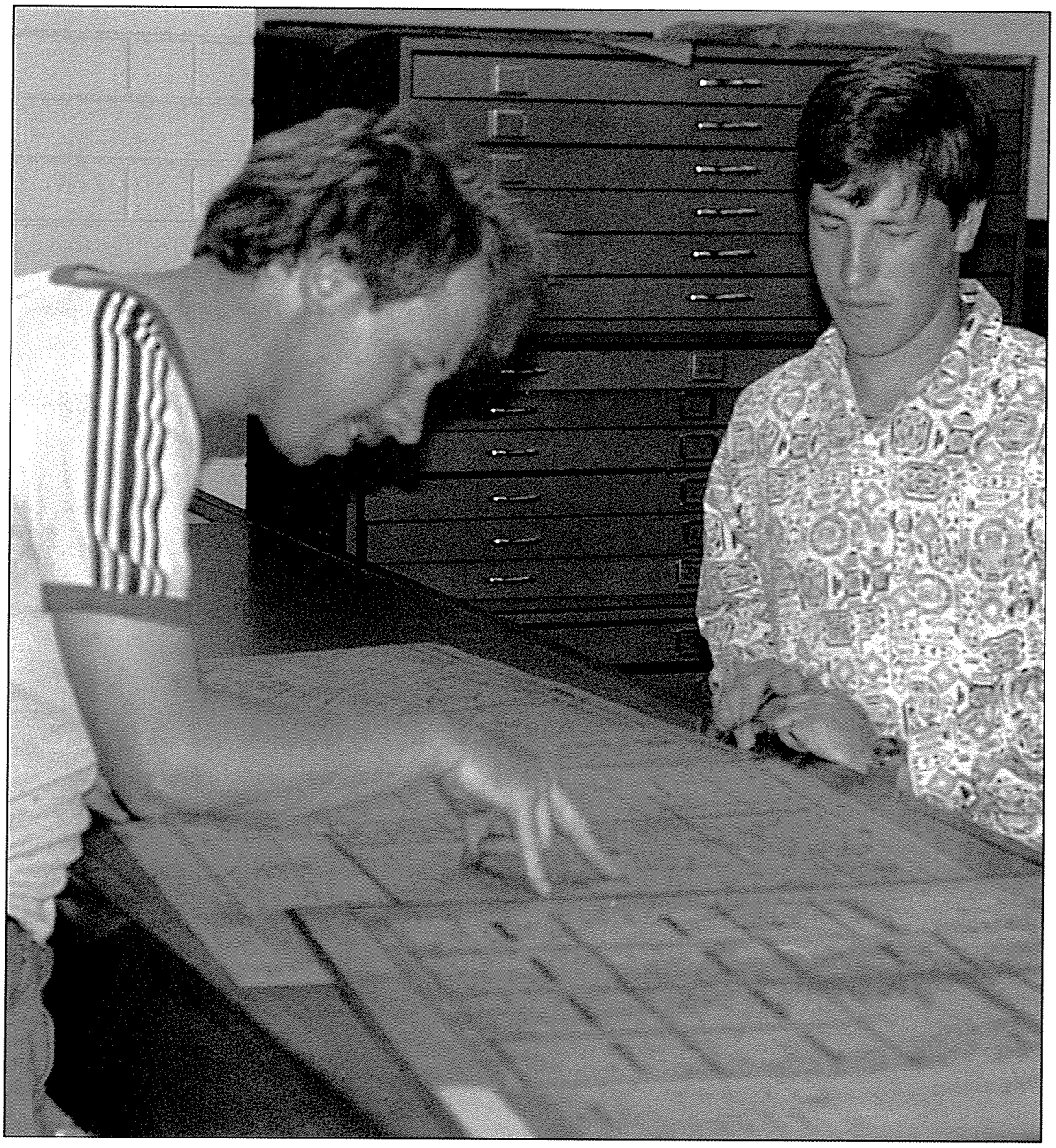
MINING REGISTRATION DIVISION

THE YEAR IN REVIEW

Computerisation

Development of the Departments' computerised mining tenement index system (TENDEX) continued. The recording of rental payments, expenditure reporting and exemptions was completed for all live mining tenements granted under the Mining Act 1978. During 1991-92 this subsystem (known as TRAX) will be progressively implemented in the various Mining Registrars' offices, commencing with Kalgoorlie.

The TENDEX system continued to be well patronised by industry with some 10 500 pages of TENDEX information being printed during the year.



Kalgoorlie has one of the busiest mining registrar's offices in the State. Here, prospector Mike Doyle (left) is given some friendly assistance from Mines Department counter clerk Scott Montgomery.

Cartographers Map the Way Ahead

" From the viewpoint of customers, they are now getting updated maps and other related information quicker than ever before."

On 3 January 1894, surveyor Robert J. Gledden surveyed the first piece of mining land for the Department of Mines.

It was an 18-acre mining lease for gold at Mount Burgess, just north of Coolgardie.

As was the custom in those days, details of the surveyor's field book were interpreted by a departmental draftsman and then drawn on to an official map.

This ink-to-paper process became the accepted method for updating mining tenement maps in Western Australia for many years to come.

Until recently many of the Department's geological, cadastral, environmental and other thematic maps were produced in a similar manner.

However, a series of major technological advances during the last couple of years has suddenly turned things around.

These changes have been progressive since February 1989 and include: the introduction of computer-aided drafting, followed by a Geographical Information System capability, a Global Positioning System capability and the first stages of a Computer-Assisted Map Publishing program. All assist the Department in meeting its obligations for the State's Integrated Land Information Program.

The introduction of these new systems brought inevitable disruption and changes to the nature of tasks undertaken by cartographic staff within the Department.

Despite all this, the Director of the Surveys and Mapping Division, Mr Les Annison, has praised his staff for the positive way they have embraced the new technology.

"For those directly involved, it was a quantum leap over traditional work procedures," Mr Annison said.

Mr L (Les) Annison, LS
Director, Surveys and Mapping Division

"Although many of our cartographers have inherent skills to identify with things of a three-dimensional nature, the introduction of the new computer-based equipment nevertheless represented a major cultural change.

"A series of training and re-training programs helped prepare them for the arrival of the new technology. To their credit, they have responded enthusiastically to the challenge.

"The net result is greater job satisfaction for our cartographers and a more streamlined mapping system for the Department and our customers."

From the viewpoint of customers, they are now getting updated maps and other related information quicker than ever before.

Despite this, there is a strong expectation from some clients that the Department should be providing "instant mapping" facilities.

Another current demand, principally from mineral and petroleum exploration companies, is for the provision of map-related information in a digital format.

Many of these companies operate extensive data bases, and they want rapid access to digitised information so they can "value-add" them in conjunction with their own mapping systems.

The Department already makes available to the public a limited amount of digital mapping information on parts of the South West. This service is provided on a cost-recovery basis.

"We are gearing up to progressively provide more of this kind of information," Mr Annison said.

"Initially, we'll be looking at key mineral and petroleum activity areas of the State.

"However, to meet the expectations of industry including an up-to-the-minute map revision capability, will require additional resources, both funding and staffing.

"In this day and age of accountability, any commitment to provide such a valuable service would need to be tempered with a responsibility to provide a suitable return on the potential investment involved."

As part of the process of developing an efficient map information service, the Department has built up extensive data exchange links across kindred government agencies in the Eastern States and overseas.

Mr Annison said: "This interaction, on a personal level, is proving invaluable in that we are able to tap the knowledge of experts."

"Effectively we are profiting from the experience of others, and, in many situations, it means we can develop worthwhile mapping systems without having to re-invent the wheel."

Mr Annison said keeping up with the very latest trends in mapping was extremely important. It was part of the on-going challenge of accommodating the seemingly endless thirst for land-based information.

Peter Walby (left) instructs cartographers Tom Lenane, Shaun Coldicutt and Liesma Kukuls in the graphic capabilities and operational procedures of Microstation.

SURVEYS AND MAPPING DIVISION

THE YEAR IN REVIEW

INTRODUCTION

The past year featured the introduction of new technologies aimed at supporting the Department's corporate objectives.

An area of special achievement was computer-assisted map production. Working groups were formed to achieve the introduction of TENGRAPH (electronic public plan), survey data input (SDI), computer-aided geological map production (CAMP), computer-aided drafting (CAD), global positioning systems (GPS) and graticular sections.

A highlight for the year in the Surveys and Mapping Division was a major staff rotation program involving 21 personnel from all three branches. The management strategy is to develop a flexible work force which will address corporate needs. It is planned to conduct the staff rotation program on a yearly basis.

Many staff attended training courses as part of a continuing professional development program. Topics were diverse, ranging from management and information technology, graphic information systems, global positioning systems, bush survival skills and the mining industry in general.

A personal computer-based time management/job costing system aimed at supporting divisional program management initiatives was introduced during the year. This will allow full and notional charges to be assessed in job costings.

More detailed notes in the Surveys and Mapping Division's activities are presented below using the Department's Corporate Plan program and sub-program headings.

MINERAL AND PETROLEUM TITLES

Titles Systems

Mapping

During the year 4 166 plans relating to mining tenements throughout the State were maintained.

A program of producing public plans at a uniform mapping scale is now complete, apart from 16x 1: 250 000 sheets.

For the year, 4 949 mining tenement applications were charted with 8 065 mining tenements cancelled from public plans.

As part of a new initiative to improve access to Petroleum exploration areas, mapsheets at 1: 000 000 scale showing advertised Canning Basin areas were introduced.

Tengraph

A major development is the TENGRAPH system which will provide a computer-based display of graphical mining tenement information, together with other land information. It will be the corporate graphical database which will interface with other textural data bases such as the mining tenement index system TENDEX.

TENGRAPH will be an electronic public plan which when fully implemented will replace the current analog public plan. This is a major project with 4 166 plans currently being maintained in the overall public plan system for the State.

TENGRAPH will be implemented in stages, commencing in the Eastern Goldfields region which comprises about 50% of current mining tenements. It will then expand in a cellular approach to eventually cover the entire State. The system will provide new products in terms of digital data usable throughout the whole of government and additional services to the mining industry.

Surveys of Tenements

A total of 233 mining tenements were surveyed at an average area of 368 heactares compared with 271 hectares in 1989-90. The number of surveys were the total which could be accommodated within the constraints of a substantially reduced survey budget.

The number of tenements awaiting survey has risen to 3 022, inviting a further

consideration of survey techniques and costing represented by limited marking, global positioning systems and user pays.

The Mining Act Regulations were amended to allow for the implementation of a user-pays system for tenement surveys as from 1 July 1991. A survey fee will no longer be payable to the Department with applicants responsible for arranging and bearing the full cost of survey.

Microfilm Program

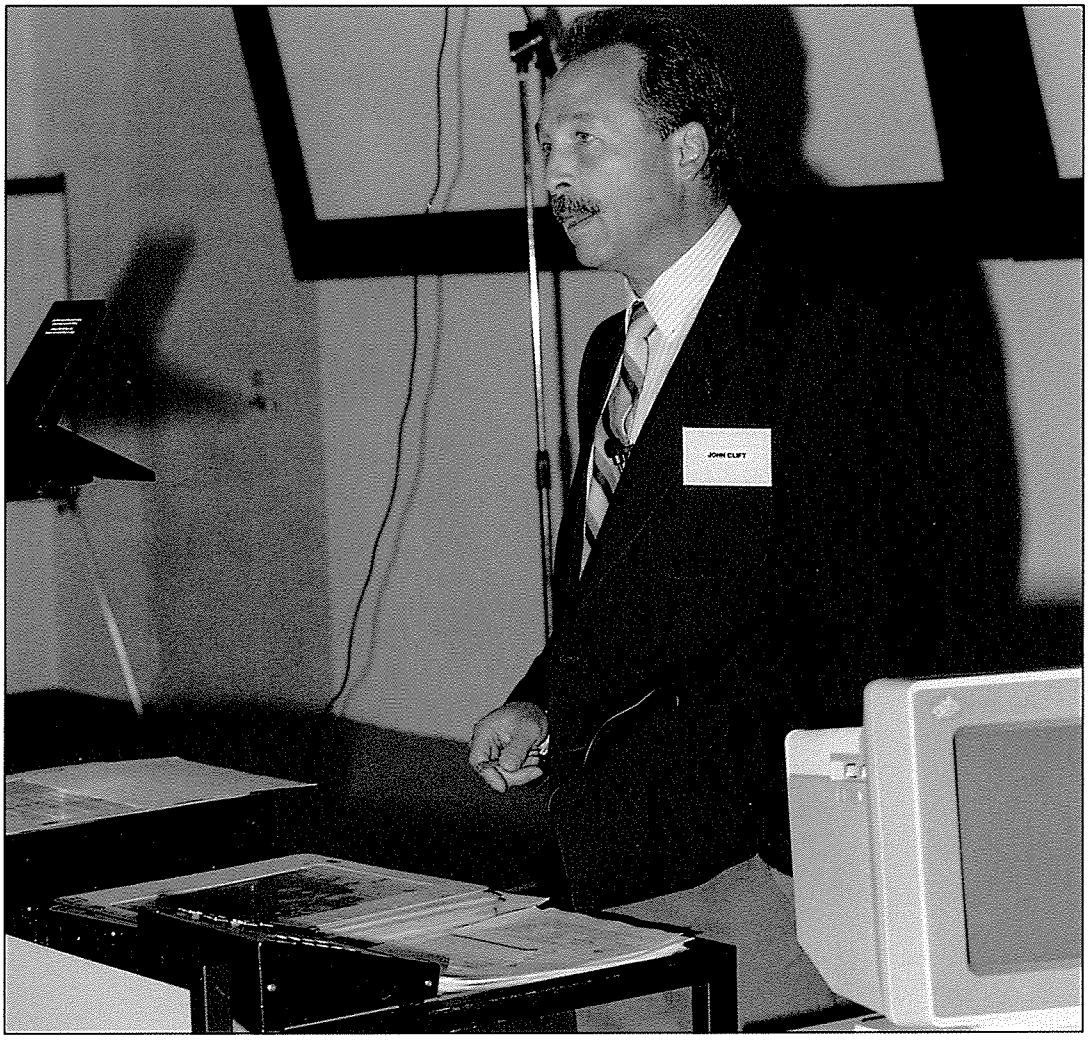
The Mapping Information Service records, maintains and stores microfiche documents obtained from the microfilming of original manuscripts. The microfilming program for 1990-91 included:

- approximately 75% of survey diagrams in black and white;
- the completion of filming of all 1904 Mining Act registers; and
- field books from 'A' to 'E'.

Graticular Sections

Two mining industry seminars were held in Perth and at Kalgoorlie to help introduce the new graticular boundary system.

The Division now has full coverage of graticular section plans at all required scales,



John Clift, Manager Tenement Graphic Services, presents details of the new graticular section system for exploration licences to a mining registrars' conference.

including indexes. Mining registrars have full coverage within their jurisdiction.

A total of 198x 1: 250 000 and 17x 1: 100 000 geological graticular section overlay maps were introduced. Of these, 86 and eight respectively were new.

EXPLORATION AND DEVELOPMENT OF NATURAL RESOURCES

Geological Data Collection

Computer-Generated Maps

The Petroleum Mapping System (WAPMAP) produced 64 seismic structure maps for a special purpose seismic structure map series. As a spinoff from these maps digital seismic data were prepared for sale.

During the year a total of 95 computer plots from the WAPMAP system were also generated to meet a variety of specialised requirements.

Landcap/Landraw

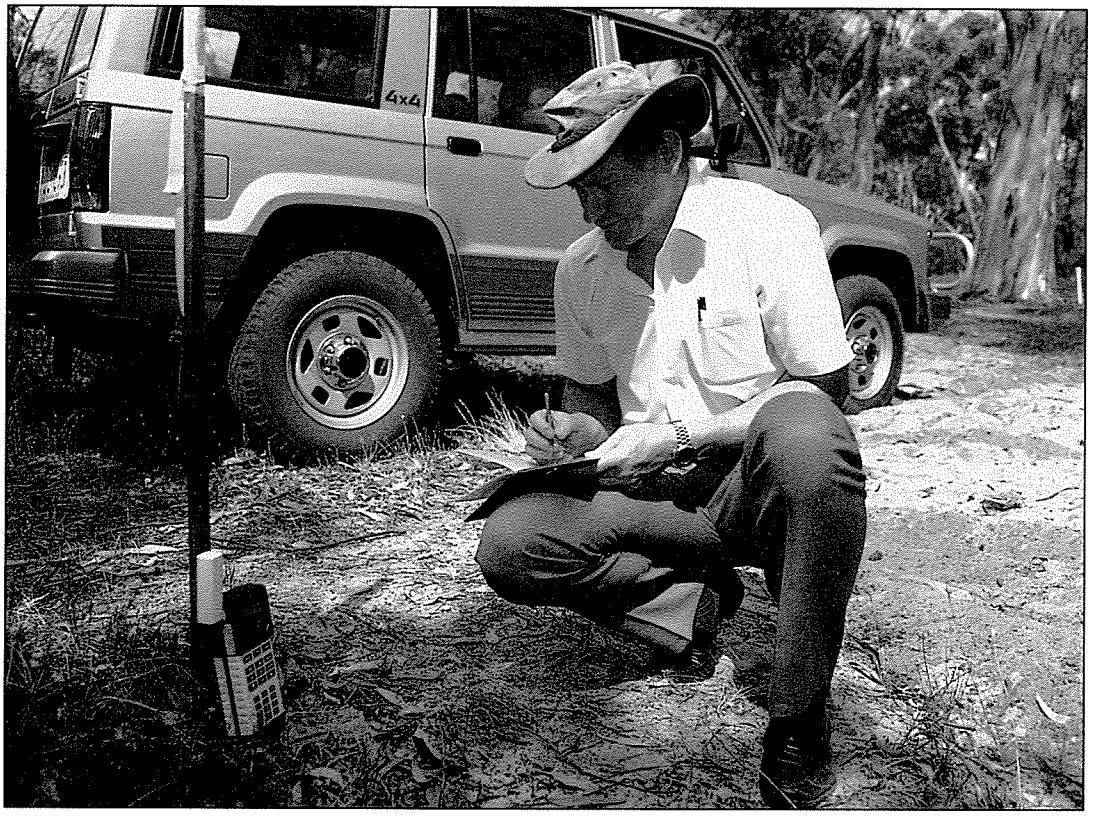
Landcap is a data entry, capture and analysis program which validates the mathematical dimensions of survey documents. Landraw, which is dependent on the Landcap file, enables the Branch to produce hard copy survey plans.

The Mining Act has been amended to reflect the Division's commitment to the preparation of all survey documents either by instruction issued by the Survey Services Branch or under the new user-pays system.

Landraw is also likely to be utilized in the preparation of the tenement title (Instrument of Lease) in conjunction with the proposed "Electronic Register".

Survey Data Input (SDI)

SDI allows the capture of survey data from existing survey documents by manual input or by digital data transfer. It is the front end of the State digital cadastral database.



Cartographic Officer Ian Robertson recording the geographic position from a satellite global positioning system receiver during a field survey.

In support of the TENGRAPH graphical database, SDI is being used to capture all surveyed mining tenements in the Eastern Goldfields region. This will be expanded to eventually cover the entire State.

Global Positioning System (GPS)

This system is an environmentally attractive and efficient technology for positioning points on the earth's surface from satellite readings.

A commitment has been made to introduce GPS for mining tenement boundary delineation and miscellaneous mapping control. Investigations have continued into hardware availability and techniques.

It is envisaged hand-held receivers will be used where less accuracy is required, while the high order survey type will be used for mining tenement marking and feature control.

The Hill River/Mt Lesueur Project, utilising GPS, involved the survey of 34 mining tenements. This was a limited marking survey which resulted in substantially reduced costs to the applicant and less damage to an environmentally-sensitive area.

Geoscientific Data Dissemination

Cartography

New technology and equipment installed during the year included digitising equipment for a pilot study to assess the computer-assisted automation of map production, an additional CAD workstation for publication work and type facilities, and an upgrade to plain paper copying equipment for plan printing.

With the aim of publishing 12 geological maps, the final printing of 11 was a good achievement, given the disrupted work program. Two of these maps were prepared and printed in seven months for the Third International Archaean Symposium in Perth (September 1990).

Significant series maps printed included Turee Creek 1: 250 000 (2nd edition) and environmental maps of Rottnest Island and Yallingup 1: 50 000, along with a set of four maps for a bulletin on the south-east Hamersley Basin.

Three thematic maps including the Administrative Map were also printed.

Publications

A total of 1 800 figures, diagrams, slides and overheads were produced for all divisions of the Department.

Computer Assisted Drafting (CAD)

A second CAD unit has expanded the Department's capacity to produce quality graphics for visual display as well as establishing type facilities which have halved type costs. The primary CAD workstation has evolved into the publication tool of the future and with a little more development will replace many of the traditional drafting procedures.

Reprographics

Safety in the workplace was paramount with the replacement of the ammonia developing plan printer with a plain paper copier.

The graphic and artwork expertise of the division has been recognised through the increasing demands on staff to support publications like the Corporate Profile, the Products and Services Guide and Safety in Mining.

Computer Assisted Map Production (CAMP)

During the year this technology supported a substantial reduction in costs and labour in the production stages against conventional colour separation techniques. A further advantage is the availability of digital data and its flexibility for future manipulation.

The computer package was evaluated with a pilot study of Cheritons Find 1:100 000 geological map sheet. Field compilations were digitised and then are electrostatic four-colour paper copy produced as a proof. Confirmation of all map data is in progress and to be

followed by the generation of final plate negatives and conventional printing.

Land Information

The Surveys and Mapping Division provides the vehicle for input to the Integrated Land Information Program (ILIP), a government agency with representatives from all Departments who have an interest in land information. The Department of Mines has now accepted custodianship of several types of land information and maintains a current listing of available digital data through the ILIP Land Information Directory (LID).

A Mines Department Searching Officer involved in land tenure research is operating within the Department of Land Administration Land Information Access (LIA). The use of this database provides information on the location and tenure of land. Use of the online Land Information Access (LIA) in conjunction with the remote search facility has enabled a more efficient response to clients.

Geographic Information System (GIS)

A final report on a pilot study covering the northwestern metropolitan region was completed and released. The report provided important input to the development of a GIS strategic plan. The plan, suggesting short to medium and long term strategies, was approved and is now being implemented.

In addition to the strategic plan, evaluation tests were conducted to find the most suitable hardware platform to run the GIS software. At the conclusion of the evaluation, an IBM RS/6 000 Unix workstation and ARC/INFO software package were purchased and installed.

Preliminary work has commenced on the Hamersley Range GIS project involving the Department of State Development. The study aims to provide a resource strategy for rational, long term development of the Pilbara ironore industry and its impact with National Park and other landuse strategies. It is expected the project will be completed by 31 October 1991.

Industry Liaison

A highlight of the year was a series of industry seminars which were particularly well received and attended. They included:

- presentations from the mining and surveying industries together with Surveys and Mapping and Mining Registration Divisions in Perth on the topical subjects of new pegging regulations, exploration licences, GPS, survey data storage, user-pay systems and document production (Landcap/Landraw).
- two graticular section seminars in Perth and Kalgoorlie with presentations from Surveys and Mapping and Mining Registration Divisions. The seminars and an information pamphlet "Exploration Licences Graticular Boundary System" helped to ensure a smooth introduction of the graticular sections system for exploration licences.

ENVIRONMENTAL PROTECTION AND REHABILITATION

The Department's two State and one regional Environmental Reserve Maps were maintained and continously updated. These maps were in strong demand and are proving invaluable in the assessment of environmentally-sensitive and restricted lands.

Also:

- the 113 EPA areas outlined in the submission to the taskforce EPA recommendations have proved a useful tool in defining EPA boundaries on all the maps;
- the digital capture of EPA Systems 5, 7, 8 and 9 is now complete and the information transferred to the EPA. Information for Sytems 1, 2, 3 and 4 is to be received from CALM and System 6 from WAWA;
- royalties on the Aboriginal lands project have been identified and entered into

Planmon, a plan monitoring data base, while mining tenement encroachments have been entered into Tendex. This information will now be merged on the mainframe to enable various reports to be produced;

- an ongoing project involves the capture of about 3 000 conservation reserves into Planmon, and the capture into Tendex of all mining tenement encroachments; and
- the Working Group is at present studying a proposal to enable mining tenement encroachments onto gazetted rare flora (GRF) to be detected at the appraisal stage and the holder alerted to contact CALM while keeping the exact location of the GRF confidential.

COMMUNITY BENEFITS

Mining Information System

The task of locating and plotting mining projects and mineral deposits in the computerbased enquiry system of MINEDEX is ongoing. A total of 1 234 sites have been located and the relevant data entered.

Of these sites, 981 have been plotted onto the Graticular Plan working transparencies. These sheets will serve as dedicated plans for MINEDEX and other data.

The direction being taken at present in site location is to position all sites involved with "Notices of Intent to Mine" (NOIs). This will also assist divisional staff in their assessment of tenements to be surveyed.

Minedex is under constant review and new sites are frequently added, with some others removed or amalgamated. It shows:

- Sites completed as at 30 June 1990 — 711
- Sites completed as at 30 June 1991 — 1 234
- Sites processed during 1990-91 — 523
- Total sites at 30 June 1991 — 2 433
- Sites to be processed at 30 June 1991 — 1 199

WORKER AND PUBLIC SAFETY

Registration of Mine Plans

The indexing of mine plans is progressing steadily with this information being entered and recorded into the Minedex System.

Statistics on Mine Plans

Number of mining companies — 92
Number of plans — 1 340
Number of mine sites — 241
Number indexed — 150

CORPORATE SERVICES

All staff participated in one day strategic planning sessions, followed by progress reviews at later dates.

The sessions concentrated on identification of prime roles and objectives to support the corporate plan and developed prioritised action plans for the next 12 months.

A performance development and review system is now fully operational and involves a six-monthly review of personal objectives of all staff by their relevant supervisor.

Staff attended several conferences during the year at which papers were presented. These included:

- 33rd Australian Survey Congress, Albury/Wodonga, where Mr G. Spencer presented a paper;
- OZRI 4 (ESRI Users Conference) and AURISA 90, Canberra, where Mr S. Bandy presented a paper; and
- GIS Concepts, Curtin University, where Mr T. Brennan presented a paper.

STATISTICS

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MINING

PETROLEUM

STATISTICS

MINING TENEMENTS IN FORCE AT 30 JUNE 1991

	1978 MINING ACT			1904 MINING ACT
MINERAL FIELD DISTRICT	PROSPECTING LICENCES	EXPLORATION LICENCES	MINING LEASES AND OTHERS	MINERAL CLAIMS
01 Greenbushes			14	
04 West Kimberley	25	104	189	229
08 Ashburton	30	79	48	
09 Gascoyne	38	63	36	
12 Collie			95	
15 Coolgardie	461	58	828	
16 Kunanalling	250	14	144	
20 Cue	178	31	170	
21 Day Dawn	64	5	49	
24 Broad Arrow	348	8	322	
25 Bulong	193	18	60	
26 East Coolgardie	251	10	367	
27 Kanowna	180	15	100	
28 Kurnalpi	90	70	49	
29 Menzies	108	26	128	
30 Ularring	21	14	83	
31 Yerilla	83	31	71	
36 Lawlers	174	42	206	25
37 Mt Malcolm	503	64	237	
38 Mt Margaret	285	72	198	
39 Mt Morgans	227	62	162	
40 Niagara	58	10	61	
45 Pilbara	225	185	337	
46 Nullagine	123	20	66	
47 West Pilbara	101	120	214	
51 Meekatharra	290	65	278	
52 Peak Hill	84	152	203	
53 Wiluna	97	97	192	
57 Black Range	123	42	109	160
58 Mt Magnet	110	17	167	
59 Yalgoo	117	114	180	
63 Dundas	74	46	192	
66 Northhampton		3	1	
69 Warburton		35	1	
70 South West	129	167	518	4
74 Phillips River	12	21	48	1
77 Yilgarn	363	108	418	
80 Kimberley	89	199	182	
TOTAL	**5504**	**2187**	**6723**	**419**

Total Area of Mining Tenements in Force

As at	Area (hectares)	As at	Area (hectares)
Dec 83	10 505 270	June 88	26 998 964
Dec 84	17 308 525	June 89	26 278 115
June 85	18 414 443	June 90	22 107 826
June 86	17 496 124	June 91	20 472 186
June 87	22 232 171		

STATISTICS

MINING AND PETROLEUM INDUSTRY EMPLOYEES

MINERAL Company	LOCATION	1989-90	1990-91
BASE METALS			
BHP Minerals Ltd	Cadjebut	186	162
Murchison Zinc Co. Pty Ltd	Golden Grove	284	277
TOTAL BASE METALS		**470**	**439**
BAUXITE - ALUMINA			
Alcoa of Australia Ltd	Del Park-Huntley/Pinjarra	1 853	2 220
	Jarrahdale/Kwinana	1 620	1 748
	Wagerup/Willow Dale	558	911
Worsley Alumina Pty Ltd	Boddington/Worsley	1 110	1 198
TOTAL BAUXITE - ALUMINA		**5 141**	**6 077**
COAL			
Griffin Coal Mining Co. Ltd	Collie	558	551
Western Collieries Ltd	Collie	748	734
TOTAL COAL		**1 306**	**1 285**
DIAMOND			
Argyle Diamond Mines Pty Ltd	Lake Argyle	828	694
Poseidon Ltd	Bow River	119	102
TOTAL DIAMOND		**947**	**796**
GOLD			
Arimco NL	Gidgee	139	140
Asarco Australia Ltd	Wiluna	184	151
Ashton Gold	Cork Tree Well	124	149
Australian Consolidated Minerals Ltd	Golden Crown	91	76
	Westonia	60	19
Australian Mine Management Pty Ltd	Mt Pleasant	119	106
	Racetrack/Royal Standard	11	36
Australmin Pacific Ltd	Tuckabianna	81	111
Aztec Mining Co Ltd	Bounty	108	143
BHP Minerals Ltd	Gimlet South/Orban JV	111	151
Big Bell Mines Pty Ltd	Big Bell	275	208
Broken Hill Metals NL	Hopes Hill	144	95
Central Norseman Gold Corp. NL	Central Norseman	399	197
Consolidated Exploration Ltd	Davyhurst	44	44
	Lady Bountiful	89	62
Coolgardie Gold NL	Greenfield	101	123

STATISTICS

MINING AND PETROLEUM INDUSTRY EMPLOYEES

MINERAL Company	LOCATION	1989-90	1990-91
GOLD continued			
Dominion Mining Ltd	Labourchere/Nathans	70	80
	Meekatharra	297	260
	Mt Morgans	163	174
	Tower Hill	81	89
Eastmet Ltd	Youanmi	79	113
Forsayth Pty Ltd	Lawlers	90	87
	Mt Gibson	277	134
Hedges Gold Pty Ltd	Hedges	113	124
Hill 50 Gold Mine NL	Mt Magnet	371	318
Kalgoorlie Consolidated Gold Mines Pty Ltd	Kalgoorlie	1 507	1 446
Metana Minerals	Reedy	144	118
	Rothsay	77	-
Newcrest Mining Ltd	New Celebration	310	382
	Telfer	525	740
Pancontinental Pty Ltd	Kundana	21	80
	Paddington	184	176
Placer Pacific Pty Ltd	Granny Smith	157	193
Plutonic Operations Ltd	Plutonic	-	126
Poseidon Ltd	Kaltails	289	136
	Karonie	60	61
Reynolds Yilgarn Gold Operations Ltd	Yilgarn	221	204
Sons of Gwalia NL	Sons of Gwalia	152	121
Spargos Mining Pty Ltd	Bellevue	178	227
St. Barbara Mines Ltd	Meekatharra	141	157
Sundowner Minerals NL	Darlot	96	107
Western Mining Corporation Ltd	Emu	120	122
	Kambalda	190	232
	Lancefield	115	137
Worsley Alumina Pty Ltd	Boddington	402	405
All Other Operators		2 322	2 126
TOTAL GOLD		**10 832**	**10 486**
HEAVY MINERAL SANDS			
Allied Eneabba Pty Ltd	Eneabba	131	107
Associated Minerals Consolidated Ltd	Capel	237	178
	Eneabba/Narngulu	610	450
Cable Sands Pty Ltd	Capel	243	185
ISK Minerals Pty Ltd	Picton	69	66

STATISTICS

MINING AND PETROLEUM INDUSTRY EMPLOYEES

MINERAL Company	LOCATION	1989-90	1990-91
HEAVY MINERAL SANDS continued			
TiWest Pty Ltd	Cataby/Chandala	178	303
Westralian Sands Ltd	Capel	530	434
All Other Operators		39(r)	35
TOTAL HEAVY MINERAL SANDS		**2 037(r)**	**1 758**
IRON ORE			
BHP Iron Ore (Goldsworthy) Ltd	Pilbara/Port Hedland	906	1 001
BHP Minerals Ltd	Yampi	422	341
	Yandicoogina	-	230
Hamersley Iron Pty Ltd	Tom Price - Paraburdoo/Dampier/Channar	3 168	3 206
Hancock Mining Ltd	Ferro Gully	56	47
Mt Newman Mining Co. Ltd	Newman/Port Hedland	3 657	3 521
Robe River Mining Co. Pty Ltd	Pannawonica/Cape Lambert	981	897
TOTAL IRON ORE		**9 190**	**9 243**
NICKEL			
Agip Australia Pty Ltd	Radio Hill	-	153
Western Mining Corporation Ltd	Kalgoorlie	384	381
	Blair/Kambalda	1 810	1 617
	Kwinana Refinery	338	299
	Leinster	551	538
	Mt Windarra	344	249
All Other Operators		18	13
TOTAL NICKEL		**3 445**	**3 250**
PETROLEUM PRODUCTS			
Hadson Energy Pty Ltd	Harriet/Rosette	74	130
West Australian Petroleum Pty Ltd	Dongara	8	8
	North West Area	207	229
Western Mining Corporation Ltd	North Herald/South Pepper/Chervil	157	108
Woodside Offshore Petroleum Pty Ltd	North Rankin A/Burrup Peninsula	1 404	1550
All Other Operators		19	23
TOTAL PETROLEUM PRODUCTS		**1 869**	**2 048**
SALT			
Dampier Salt Ltd	Dampier	178	183
	Lake MacLeod	114	120
Leslie Salt Co.	Port Hedland	120	121

STATISTICS

MINING AND PETROLEUM INDUSTRY EMPLOYEES

MINERAL Company	LOCATION	1989-90	1990-91
SALT continued			
Shark Bay Salt JV	Useless Loop	86	79
TOTAL SALT		**498**	**503**
ALL OTHER MATERIALS (including Rock Quarries)		**841**	**945**
TOTAL		**36 576(r)**	**36 830**

(SOURCE: AXTAT REPORTING SYSTEM, MINING ENGINEERING DIVISION)

WATER DRILLING AND ASSOCIATED WORKS

Location	Purpose	Type of Work	No. of Bores	Metres Drilled
Dongara Line	Groundwater Investigation	Mud Rotary	4	416.25
Leeman Shallow	Groundwater Investigation	Wireline Coring & Mud Rotary	12	112.11
Nu-farm Kwinana	Pollution Monitoring	Mud Rotary Coring	12	112.11
Total:			**41**	**2 153.57**

STATISTICS

QUANTITY AND VALUE OF MINERALS

MINERAL	UNIT	1989-90 QUANTITY	1989-90 VALUE($A)	1990-91 QUANTITY	1990-91 VALUE($A)
BARYTES	t	7 521	1 006 603	0	0
BASE METALS					
Copper	t	14 979	23 922 443	11 995	20 349 205
Lead	t	13 171	7 604 934	7 179	3 736 319
Zinc	t	45 878	59 754 974	57 330	60 461 840
TOTAL BASE METALS			91 282 351		84 547 364
BAUXITE-ALUMINA					
Alumina	t	6 651 028	2 335 697 184	6 800 451	2 099 125 726
CLAYS					
Attapulgite	t	28 137	3 988 107	15 403	3 914 836
Cement Clay	t	21 952	54 880	22 994	137 964
Fire Clay	t	279 538	511 780	620	744
Kaolin	t	7 701	472 291	0	0
White Clay	t	32 401	324 010	139 000	1 529 000
TOTAL CLAYS			5 351 068		5 743 262
COAL	t	4 160 646	183 698 442	5 218 176	232 915 908
CONSTRUCTION MATERIALS					
Aggregate	t	150 814	754 854	102 945	435 358
Gravel	t	44 981	213 086	30 952	152 200
Rock	t	108 198	800 585	43 135	454 534
Sand	t	729 863	2 693 633	548 673	2 327 258
TOTAL CONSTRUCTION MATERIALS			4 462 158		3 369 350
DIAMOND	ct	33 854 620	413 583 727	29 964 155	435 725 448
DIATOMITE	t	0	0	22	160
DIMENSION STONE					
Black Granite	t	1 239	1 789 485	249	76 706
Quartz Rock	t	994	43 341	430	19 302
Quartzite	t	59	2 360	0	0
Spongolite	t	2 280	145 354	115	9 430
TOTAL DIMENSION STONE			1 980 540		105 438

STATISTICS

QUANTITY AND VALUE OF MINERALS

MINERAL	UNIT	1989-90 QUANTITY	1989-90 VALUE($A)	1990-91 QUANTITY	1990-91 VALUE($A)
GEM, SEMI-PRECIOUS & ORNAMENTAL STONE					
Amethyst	kg	14 594	67 958	**25**	**131 426**
Emerald	g	550	2 020	**0**	**0**
TOTAL GEM, SEMI-PRECIOUS & ORNAMENTAL STONE			69 978		**131 426**
GOLD	kg	161 789 (r)	2 596 453 778 (r)	**181 165 (e)**	**2 900 129 174(e)**
GYPSUM	t	154 809	995 281	**82 520**	**612 778**
HEAVY MINERAL SANDS					
Garnet	t	27 768	1 152 128	**22 141**	**2 071 178**
Ilmenite	t	1 071 845	89 606 326	**965 930**	**85 482 878**
Upgraded Ilmenite (a)	t	284 109	131 107 248	**263 408**	**131 710 093**
Leucoxene	t	15 023	7 902 766	**23 836**	**13 259 826**
Monazite	t	13 358	9 731 111	**6 869**	**5 113 867**
Rutile	t	82 232	58 541 710	**65 446**	**49 598 010**
Zircon	t	300 256	175 190 729	**208 424**	**100 801 777**
TOTAL HEAVY MINERAL SANDS			473 232 018		**388 037 629**
INDUSTRIAL PEGMATITE MINERALS					
Felspar	t	9 692	437 909	**34 315**	**1 346 129**
Mica	t	0	0	**2 280**	**113 597**
TOTAL INDUSTRIAL PEGMATITE MINERALS			437 909		**1 459 726**
IRON ORE					
Domestic	t	5 255 037	103 517 251	**4 368 036**	**113 955 037**
Exported	t	101 017 156	2 142 510 771	**103 304 766**	**2 534 731 534**
TOTAL IRON ORE		106 272 193	2 246 028 022	**107 672 802**	**2 648 686 571**
LIMESAND-LIMESTONE-DOLOMITE					
Dolomite	t	333	6 660	**0**	**0**
Limesand-Limestone	t	1 698 820	7 868 870	**1 738 427**	**9 853 611**
TOTAL LIMESAND-LIMESTONE-DOLOMITE			7 875 530		**9 853 611**
MANGANESE ORE	t	273 000	1 200 000	**137 961**	**21 967 054**
NICKEL INDUSTRY	t				
Cobalt by-product	t	268	4 600 916	**222**	**3 697 617**
Nickel Concentrate	t	446 453	565 370 341	**510 320**	**591 302 981**

STATISTICS

QUANTITY AND VALUE OF MINERALS

MINERAL	UNIT	1989-90 QUANTITY	1989-90 VALUE($A)	1990-91 QUANTITY	1990-91 VALUE($A)
NICKEL INDUSTRY continued					
Nickel Ore	t	37 084	20 598 342	**8 666**	**4 575 271**
Palladium by-product	kg	431	1 631 497	**350**	**1 229 183**
Platinum by-product	kg	66	1 049 022	**89**	**1 268 587**
TOTAL NICKEL INDUSTRY			593 250 118		**602 073 639**
PEAT	t	1 111	68 546	**376**	**28 000**
PETROLEUM					
Condensate	kl	1 601 163	235 653 383	**1 867 892**	**370 948 987**
Crude Oil	kl	3 962 739	601 471 936	**5 136 529**	**1 054 073 043**
LNG	MMBtu	104 167 480	336 091 222	**184 930 679**	**836 400 762**
Natural Gas	'000m3	3 847 731	356 846 939	**3 613 720**	**379 228 944**
TOTAL PETROLEUM			1 530 063 480		**2 640 651 736**
PIGMENTS					
Red Iron Oxide	t	0	0	**5757**	**110531**
RARE EARTHS					
Gallium	kg	42 986	1 454 998	**8 481**	**267 377**
SALT	t	5 924 943	124 110 422	**6 413 163**	**136 973 045**
SILICA-SILICA SAND					
Silica	t	32 544	325 435	**80 147**	**822 975**
Silica Sand	t	445 874	3 662 014	**781 503**	**6 774 328**
TOTAL SILICA-SILICA SAND			3 987 449		**7 597 303**
SILVER	kg	34 566 (r)	5 621 356	**39 775**	**6 053 366**
TALC	t	220 263	15 223 112	**161 560**	**11 691 732**
TIN-TANTULUM-LITHIUM					
Spodumene	t	47 428	8 305 325	**40 376**	**7 079 333**
Tantalite	t	439	16 169 644	**702**	**22 767 073**
Tin	t	237	1 298 492	**262**	**1 229 162**
TOTAL TIN-TANTULUM-LITHIUM			25 773 461		**31 075 568**
VERMICULITE	t	105	18 528	**507**	**90 227**
TOTAL VALUE			10 662 926 059 (r)		**12 269 023 149 (e)**

Note: Quantities used in this table only apply to Minerals and Petroleum covered by the Mining Act 1978, the Petroleum Act 1967, the Petroleum (Submerged Lands) Act 1982 and relevant State Agreement Acts.

(a) Also known as synthetic rutile (e) Estimate (r) Revised from previous edition

STATISTICS

ROYALTY RECEIPTS

Mineral	1989-90 $A	1990-91 $A	Value $A Variance	%up (%down)
BARYTES	0.00	**50 330.15**	50 330.15	n.ap.
BASE METALS				
Copper	1 116 113.23	**1 490 425.64**	374 312.41	34
Lead	227 916.33	**334 491.55**	106 575.22	47
Zinc	2 974 086.58	**3 307 359.63**	333 273.05	11
TOTAL BASE METALS	4 318 116.14	**5 132 276.82**	814 160.68	19
BAUXITE-ALUMINA				
Alumina	34 072 745.00	**33 777 840.23**	(294 904.77)	(1)
CLAYS	185 929.14	**380 489.93**	194 560.79	105
COAL	2 148 206.66	**5 236 321.85**	3 088 115.19	144
CONSTRUCTION MATERIALS				
Aggregate	50 214.90	**23 274.30**	(26 940.60)	(54)
Gravel	11 843.75	**9 741.60**	(2 102.15)	(18)
Rock	32 548.66	**19 251.12**	(13 297.54)	(41)
Sand	239 062.06	**156 610.73**	(82 451.33)	(34)
TOTAL CONSTRUCTION MATERIALS	333 669.37	**208 877.75**	(124 791.62)	(37)
DIAMOND	27 202 475.86	**27 289 552.17**	87 076.31	0
DIMENSION STONE	782.86	**1 381.15**	598.29	76
GEM, SEMI-PRECIOUS & ORNAMENTAL STONE	6 996.00	**1 103.73**	(5 892.27)	(84)
GOLD	199 362.36	**291 690.92**	92 328.56	46
GYPSUM	49 867.89	**26 911.03**	(22 956.86)	(46)
HEAVY MINERAL SANDS				
Garnet	52 912.63	**102 079.57**	49 166.94	93
Ilmenite	4 678 380.34	**4 370 511.40**	(307 868.94)	(7)
Leucoxene	500 469.64	**555 141.31**	54 671.67	11
Monazite	516 417.37	**302 211.02**	(214 206.35)	(41)
Rutile	3 101 789.38	**3 140 086.21**	38 296.83	1
Xenotime	5 292.00	**0.00**	(5 292.00)	(100)
Zircon	9 490 837.53	**5 366 172.39**	(4 124 665.14)	(43)
TOTAL HEAVY MINERAL SANDS	18 346 098.89	**13 836 201.90**	(4 509 896.99)	(25)
INDUSTRIAL PEGMATITE MINERALS				
Felspar	23 440.66	**67 753.29**	44 312.63	189
Mica	15 987.00	**6 318.09**	(9 668.91)	(60)
TOTAL INDUSTRIAL PEGMATITE MINERALS	39 427.66	**74 071.38**	34 643.72	88

STATISTICS

ROYALTY RECEIPTS

Mineral	1989-90 $A	1990-91 $A	Value $A Variance	%up (%down)
IRON ORE	112 532 211.41	**130 935 140.94**	18 402 929.53	16
LIMESAND-LIMESTONE-DOLOMITE				
Dolomite	99.90	**0.00**	(99.90)	(100)
Limesand-Limestone	139 160.12	**102 706.75**	(36 453.37)	(26)
TOTAL LIMESAND-LIMESTONE-DOLOMITE	139 260.02	**102 706.75**	(33 553.27)	(26)
MANGANESE	90 000.00	**939 488.38**	849 488.38	944
NICKEL INDUSTRY				
Cobalt by-product	82 543.36	**79 982.92**	(2 560.44)	(3)
Nickel	9 978 061.91	**10 597 322.76**	619 260.85	6
Palladium by-product	27 351.53	**23 422.80**	(3 928.73)	(14)
Platinum by-product	26 651.04	**23 302.38**	(3 348.66)	(13)
TOTAL NICKEL INDUSTRY	10 114 607.84	**10 724 030.86**	609 423.02	6
PEAT	2 602.21	**958.62**	(1 643.59)	(63)
PETROLEUM				
Condensate	2 068 390.85	**2 970 781.49**	902 390.64	44
LNG	2 265 012.95	**6 511 739.42**	4 246 726.47	187
Natural gas	5 204 344.62	**5 635 165.38**	430 820.76	8
Oil	42 239 570.30	**77 309 419.92**	35 069 849.62	83
TOTAL PETROLEUM	51 777 318.72	**92 427 106.21**	40 649 787.49	79
PIGMENTS				
Red Iron Oxide	0.00	**5 526.55**	5 526.55	n.ap.
RARE EARTHS				
Gallium	276 769.61	**116 950.60**	(159 819.01)	(58)
SALT	1 075 787.77	**1 301 673.64**	225 885.87	21
SILICA-SILICA SAND	216 768.32	**389 453.08**	172 684.76	80
SILVER	145 976.57	**115 630.15**	(30 346.42)	(21)
TALC	100 002.00	**87 917.00**	(12 085.00)	(12)
TIN-TANTALUM-LITHIUM				
Spodumene	341 091.87	**356 225.05**	15 133.18	4
Tantalite	444 982.14	**569 877.68**	124 895.54	28
Tin	50 242.60	**30 711.54**	(19 531.06)	(39)
TOTAL TIN-TANTALUM-LITHIUM	836 316.61	**956 814.27**	120 497.66	14
VERMICULITE	10 696.95	**1 246.69**	(9 450.26)	(88)
TOTAL ROYALTIES	264 221 995.86	**324 411 692.75**	60 189 696.89	24

STATISTICS

MINING ACCIDENTS

LOST TIME INJURIES IN MINES DURING 1990-91

Type of Mining	No of Employees	No of LTIs	Incidence	Frequency	Duration	Injury Index	Days Lost
Metalliferous Surface	30 388	1 406	46	22	11.6	256	16 368
Metalliferous U/Ground	2 669	299	112	54	14.5	782	4 341
Metalliferous Total	33 057	1 705	52	25	12.1	298	20 709
Coal Surface	1 009	130	129	76	8.2	620	1 061
Coal U/Ground	305	126	413	245	8.7	2 130	1 097
Coal Total	1 314	256	195	115	8.4	969	2 158
Total Mining	**34 371**	**1 961**	**57**	**27**	**11.7**	**319**	**22 867**

Duration in this table does not take into consideration time lost after 30 June 1991, time lost by persons with carry-over injuries from before June 1990, or time lost from recurrent injuries.

Definitions:

Lost Time Injury (LTI)
A work injury which results in inability to work for at least one full day or shift any time after the day or shift on which the injury occurred.

Incidence

The number of lost time injuries per thousand employees for a 12 month period.

Duration

The average number of work days lost per injury.

Frequency

The number of lost time injuries per million hours worked.

Injury Index

The number of work days lost per million hours worked.

STATISTICS

MINING ACCIDENTS

MINING ACCIDENTS FOR THE YEAR ENDED 30 JUNE 1991

Mineral	Number of Persons Employed	Accidents		
		Fatal	Serious	Minor
Gold and Nickel	13 489	6	278	609
Iron	9 307	1	84	352
Bauxite, Alumina	5 461		25	68
Mineral Sands	1 896		24	47
Coal	1 314		62	194
Diamond	966	1	23	20
Salt	515		11	33
Construction Materials	247		8	9
Other Minerals	1 176	2	37	77
TOTALS	**34 371**	**10**	**552**	**1 409**

STATISTICS

MINING ACCIDENTS

FATAL ACCIDENTS

There were ten people killed in the mining industry during 1990-91. All worked in metalliferous mines. The fatalities involved:

- A truck driver employed by contractors who was killed when the truck he was driving reversed over the edge of an ore stockpile.
- A machine miner died when struck by a rock fall during scaling operations.
- A boilermaker suffered fatal injuries when an old drill rod he was heating with an oxy torch exploded.
- A mechanical trades assistant died when he punctured a live 415 volt electrical cable during a trench digging operation.
- A jumbo operator was fatally injured when his clothing became entangled with a rotating drill steel.
- A Shift Boss suffered fatal head injuries when engulfed by a sudden rush of rock and water during clearing of an old, hung up ore pass.
- A truck driver sustained fatal injuries as a result of being thrown from the cab when his truck fell 20 metres into a roadside gully.
- A machine miner died in a shrink stope as a result of being buried in a run of broken ore on which he was standing.
- A forklift operator was killed when his forklift ran into a drain and overturned.
- A miner was killed by falling rock while endeavouring to clear a blocked mill hole.

PROSECUTIONS

- A crane driver was charged for an offence under Regulation 6.2 and Section 54 of the Mines Regulation Act. He entered a plea of guilty and was fined $500 with $28.70 costs or 22 days imprisonment in default.
- A machine miner was charged for a breach of Regulation 7.24(3) relating to drilling in a stope face containing misfires. A plea of guilty was entered in respect to the offence and he was fined $500 with $28.70 costs.
- A mining contractor with his seven employees, a registered manager and five companies who were the owners of the mine were charged with a total of 200 breaches against sections 38 and 40 of the Mines Regulation Act. The offences were related to work in or about a mine for more than 13 consecutive days without a break of not less than one full day. Convictions against the registered manager and the owners were subsequently quashed on appeal. However, the remaining defendants were found guilty on all charges and fined to a total of $55 000 with $2 429 costs.
- A miner was charged with a breach of Regulation 7.24(2) relating to boring into a butt (remains of a drill hole which could contain explosives). He was fined $300.

STATISTICS

CERTIFICATES

METALLIFEROUS MINING CERTIFICATES OF COMPETENCY ISSUED 1990-91

FIRST CLASS MINE MANAGERS

MOKOS, Peter Philip	323
HAMPEL, Brett William	324
BURGESS, John Edward	325
LOERCH, Philip Mark	326
CARR, Christopher John	327
CULLINAN, Peter Thomas	328
GREEN, Stephen Thomas	329
LENIGAS, David Anthony	330
MITT, Peter Sulev	331
ROBERTSON, Charles Cameron	332
STAPLES, Martin William	333
GROW, Geoffrey Wayne	334
FLANAGAN, Richard Owen	335
BURROWS, Bradley David	336
POTTS, Walter Freeman	337
RODGERS, Stephen John	338
CHIDLOW, James Anthony	339
EVANS, Gregory Wayne	340
SPENCER, Bruce Dalrymple	341

UNDERGROUND SUPERVISORS

DEAN, Wayne George	A688
RAYNER, Francis Joseph	A689
PETHER, Stuart James	A690
PEARSON, Christopher Leslie	A691
POTTS, Walter Freeman	A692
DAWSON, Craig	A693
PECKHAM, Michael John	A694
RUSSELL, Donald Roderick	A695
DOWN, Matthew Bernard	A696
HARTLEY, Robert Edward	A697
KELLY, Raymond John	A698
KUBOSZEK, Stanislaw	A699
LOW, Francis Cheng-Wai	A700
PARR, Frederick Glenn	A701
SOLDINI, Juan Raul	A702
YOUNG, Darryl John	A703
GORZALA, John Francis	A704
GILLIAM, Thomas Andrew	A705
MATHER, Robert Falcon	A706
BRADFORD, Robert Bathurst	A707
RYMER, Gregory Arthur	A708
BORLAND, Bryce Leslie	A709
BURNS, Dale Reginald	A710
CHALLIS, Lyall Jeffrey	A711
CHAPLYN, Andrew Brian	A712
DOHERTY, James Brenden	A713
GREEN, John William	A714
GRIFFIN, Paul Vincent	A715
HIGGINS, Wayne Thomas	A716
HUGHES, Robert Mark	A717
KROLLIG, Alan Walter	A718
LAUFMANN, Richard	A719
LAW, Stuart Keith	A720
MEYER, Karl-Heinz	A721
O'BYRNE, Shane John	A722
O'LOUGHLIN, Peter Domonic	A723
PACEY, Rowan	A724
PARAHA, Isaac James Dean	A725
PROELSS, John Otto	A726
PROELSS, Michael Leigh	A727
REILLY, Henry	A728
SAUNDERS, Northey Revell	A729
SMITH, Trevor Urwin	A730
TILY-LAURIE, Eric Ewen	A731
TITCHENER, Trevor Leslie	A732
WILSON, Leslie James	A733
YOUNG, Darryl John	A734
URQUHART, Stuart Clinton	A735
PARR, Frederick Glenn	A736
SIMMONS, Jeffrey Roy	A737
JAMES, Anthony Paul	A738
ROGERS, Dale Clark	A739
RODGER, Michael Joseph	A740
CASTRO-ROJAS, Sergio Alfredo	A741
WARBURTON, Robert John	A742
BREMNER, Philip John	A743
LEIGHTON, Ross Clarence	A744
BERG, David James	A745
CURRIE, John Charles Hamilton	A746

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LENARTOWICZ, Derek	229
MILLARD, Christopher John	230
STODDART, John James	231
DANCKERT, Gerard Michael	232
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FAIR, Warren Barry	234
HAMEL, Perry Mark	235
O'CONNOR, Geoffrey Mark	236
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TIVER, Alastair George	239
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PURDEY, David Paul	241
LEE, Christopher Gavin	242
BELL, Nicholas	243
DENHAM, Peter Edward	244
LUCAS, Matthew Peter	245
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MOORE, Robert Michael	247
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SALMOND, Brian David	249
STOCKS, Andrew James	250
GIBSON, Thomas	251

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CERTIFICATES

RESTRICTED QUARRY MANAGERS

BOWRA, Robert Harold 330
KASCHULL, Hans Jurgen 331
MUNRO, Kevin Noel 332
ANARU, Tamihana Perry 333
ATKINSON, Athol Bryan Mervyn 334
BARTLETT, David Anthony 335
BASSETT, Craig 336
BLACKWELL, Robert Stephen 337
BOLIVER, Leslie James 338
BOWMAN, Gordon William 339
CAIRNS, John Marshall 340
COOPER, Trevor William 341
DOBRICH, Glendon Frederick 342
FOGARTY, Daniel Patrick 343
GARDINER, Bruce Strickland 344
HASLAM, Andrew Malcolm 345
HILL, Leon Victor 346
JEISMAN, William Arthur 347
LAMBERT, Stephen Arthur Sidney 348
LEWIS, Brian Ernest 349
MC CARTHY, John Maurice 350
MC INTOSH, Peter Maxwell 351
MORA, Peter Norman Mark 352
NUTTALL, Timothy James 353
RADOSEVICH, David Laurence 354
SALLIE, Ian 355
SAVILLE, Ian James 356
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HUITSON, John Arthur 369
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KING, Michael Robert 371
MC BRIDE, David Neil 372
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SLATER, Thomas Graham Conrad 374
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BATTEN, Peter John Robert 376
BONWICK, Martin James 377
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SALMOND, Brian David 379
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BUTCHER, Stephen John 382
PANTING, Russell John 383
BULLOCH, Alasdair George 384
HOCKLEY, Reginald Edward 385

AUTHORISED MINE SURVEYORS

BAYLEY, Paul Grant 134
COWCILL, Brian Christopher 135
DOHERTY, Stephen Patrick 136
EVANS, David Paul 137
GORDON, Michael Francis 138
HUNTER, David William 139
JASPER, Peter Francis 140
JEAVONS, Christopher Chay 141
LAMB, Brett Francis Adam 142
MC COMISH, Mark 143
MC CULLOCH, Alexander John 144
NILSSON, Paul Christopher 145
RANSTED, Douglas Arthur 146
VOGEL, John William 147
HAVELKA, Mark 148

COAL MINING CERTIFICATES OF COMPETENCY ISSUED 1990-91

FIRST CLASS MINE MANAGERS

ROSE, Vincent A-2-90

THIRD CLASS (DEPUTIES)

KOLE, Richard Jozef C-1-90
AUDINO, Larry C-1-91
MARLEY, Michael James C-2-91

OPEN CUT MINE MANAGERS

BAILEY, Thomas Raymond D-1-91
HATCH, David Frank D-2-91

STATISTICS

PETROLEUM PRODUCTION 1990-91

Field	Crude Oil (kL)	Condensate (kL)	Gas (10^3m^3)
Barrow Island	812 149		84 668
Beharra		77	5 268
Blina	13 350		
Boundary	1 756		
Chervil	90 777		41 507
Cowle	31 482		2 505
Dongara	5 330	448	106 728
Harriet	780 765		94 362
Lloyd	1 193		
Mondarra		56	5 348
Mt Horner	32 593		
N.Herald	66 670		9 667
N. Rankin		1 842 387	12 716 491
N. Yardanogo	30		
Saladin	2 509 792		199 723
S. Pepper	325 839		97 921
Sundown	1 171		
Talisman	315 736		2 997
W. Kora	789		
W. Terrace	1 467		
Woodada		891	104 880
Yammaderry	58 478		4 352
TOTAL	**5 050 087**	**1 843 859**	**13 476 417**

Note: These are gross production and not sales figures. Of the North Rankin gas production approximately $3.5*10^9m^3$ was injected and $4.7*10^9m^3$ was used for LNG production.

STATISTICS

PETROLEUM EXPLORATION PERMIT DEALINGS

	1989-90		1990-91	
	No.	**AREA (KM)**	**No.**	**AREA (KM)**
AREA ADVERTISED				
Onshore	8	14 774	4	95
Offshore	17	88 861	27	225 501
TOTAL	**25**	**103 635**	**31**	**225 596**
PERMITS GRANTED				
Onshore	5	11 609	8	37 531
Offshore	3	18 207	8	25 779
TOTAL	**8**	**29 816**	**16**	**63 310**
PERMIT APPLICATIONS (pending at year's end)				
Onshore	4		2	
Offshore	2		10	
TOTAL	**6**		**12**	
PERMITS HELD (at year's end)				
Onshore	57	226 980	50	163 770
Offshore	42	160 196	47	127 936
TOTAL	**99**	**387 176**	**97**	**291 706**
PERMITS SURRENDERED				
Onshore	10	47 182	10	89 791
Offshore	2	5 980		
TOTAL	**12**	**53 162**	**10**	**89 791**
PERMIT RENEWALS				
Onshore	5	14 878	5	29 355
Offshore			1	2 096
TOTAL	**5**	**14 878**	**6**	**31 451**
PERMITS CANCELLED				
Onshore			4	26 217
Offshore				
TOTAL			**4**	**26 217**
PERMITS EXPIRED				
Onshore	3	21 764		
Offshore	2	3 851	1	5
TOTAL	**5**	**25 615**	**1**	**5**
LICENCES HELD (including pipelines)				
Onshore	21	3 110	22	3 110
Offshore	20	3 381	21	3 462
TOTAL	**41**	**6 491**	**43**	**6 572**

STATISTICS

PETROLEUM WELLS DRILLED

Class	Name	Operator	Title	Latitude	Longitude	Ground Elev	KB Elev	Depth @ 30.6.91	Spud Date	Rig Release Date	Status @ 30.6.91
					Bonaparte Basin						
NFWO	Stork 1	LASMO	WA-199-P	11 29 29	125 47 33	-75	11	1400	28.09.90	14.10.90	P & A
					Browse Basin						
NFWO	Trochus 1	SHELL	WA-207-P	15 55 30	121 06 01	-69	25	1622	13.03.91	3.04.91	P & A
					Canning Basin						
EXT	Blina 8	PETSEC	PL-6	17 37 11	124 29 28	55	59	1550	17.07.90	1.08.90	P & A
	Pictor 2	BRIDGE	EP 175	18 45 57	123 42 49	130	137	1085	11.11.90	5.12.90	P & A
NFW	Boundary 1	PETSEC	EP 129	17 29 10	124 14 37	44	51	1670	6.08.90	23.08.90	O SUSP
	Scarpia 1	KUFPEC	EP 101	18 03 13	124 50 36	98	105	1600	15.10.90	2.11.90	P & A
					Carnarvon Basin						
DEV	Barrow B43A	WAPET	PL-1H	20 52 10	115 20 55	2	5	740	31.05.91	5.06.91	O SUSP
	Barrow E21A	WAPET	PL-1H	20 50 08	115 24 04	27	32	723	22.04.91	28.04.91	O
	Barrow F22A	WAPET	PL-1H	20 50 07	115 22 28	31	36	714	22.06.91	26.06.91	O SUSP
	Barrow F24A	WAPET	PL-1H	20 50 07	115 22 53	39	44	725	16.06.91	20.06.91	O SUSP
	Barrow F25A	WAPET	PL-1H	20 50 09	115 23 07	34	39	728	7.06.91	13.06.91	O SUSP
	Barrow F42A	WAPET	PL-1H	20 50 34	115 22 29	31	36	710	4.04.91	11.04.91	O
	Barrow F43A	WAPET	PL-1H	20 50 35	115 22 42	23	28	708	17.03.91	24.03.91	O
	Barrow F44A	WAPET	PL-1H	20 50 32	115 22 55	20	25	703	26.03.91	2.04.91	O
	Barrow F55MA	WAPET	PL-1H	20 50 42	115 23 16	17	22	935	19.12.90	18.01.91	O
	Barrow F61A	WAPET	PL-1H	20 50 54	115 22 14	33	38	718	12.04.91	20.04.91	O
	Barrow F82F	WAPET	PL-1H	20 51 30	115 22 25	5	10	946	22.12.90	7.01.91	O
	Barrow G28A	WAPET	PL-1H	20 50 08	115 21 59	35	40	333	28.06.91		DRILLING
	Barrow G88B	WAPET	PL-1H	20 51 32	115 22 11	7	12	1207	20.01.91	8.02.91	O
	Barrow L41A	WAPET	PL-1H	20 48 50	115 22 13	41	46	760	30.10.90	8.11.90	O
	Barrow L42A	WAPET	PL-1H	20 48 50	115 22 30	48	53	765	21.10.90	28.10.90	O
	Barrow L43A	WAPET	PL-1H	20 48 51	115 22 44	48	53	765	11.10.90	19.10.90	O
	Barrow L44A	WAPET	PL-1H	20 48 49	115 22 55	50	55	765	1.10.90	9.10.90	O
	Barrow L45A	WAPET	PL-1H	20 48 50	115 23 08	51	56	762	24.05.91	29.05.91	O
	Barrow L46A	WAPET	PL-1H	20 48 49	115 23 22	58	63	777	15.05.91	23.05.91	O
	Barrow L47A	WAPET	PL-1H	20 48 49	115 23 36	51	56	767	6.05.91	13.05.91	O
	Barrow L48A	WAPET	PL-1H	20 48 50	115 23 51	41	46	775	29.04.91	4.05.91	O
	Barrow L61A	WAPET	PL-1H	20 49 15	115 22 12	41	46	760	21.11.90	26.11.91	O
	Barrow L62A	WAPET	PL-1H	20 49 16	115 22 26	46	50	760	10.11.90	20.11.90	O
	Barrow L81A	WAPET	PL-1H	20 49 42	115 22 13	43	48	755	27.11.90	2.12.90	O
	Barrow L82A	WAPET	PL-1H	20 49 43	115 22 27	35	40	743	4.12.90	10.12.90	O
	Barrow L82GW	WAPET	PL-1H	20 49 40	115 22 41	37	42	730	12.02.91	14.02.91	O
	Barrow L84A	WAPET	PL-1H	20 49 41	115 22 56	37	42	760	11.12.90	18.12.90	O
	Tubridgi 7	DORAL	L9	21 46 35	114 50 28	2	6	600	19.09.90	2.10.90	G SUSP
	Tubridgi 8	DORAL	L9	21 47 53	114 50 26	2	6	598	5.10.90	23.10.90	G SUSP
DEVO	North Herald 4	WMC	TL/2	21 10 31	115 15 50	-18	33	1337	11.07.90	16.07.90	P & A
	North Herald 5	WMC	TL/2	21 10 31	115 15 50	-18	33	1190	2.07.90	11.07.90	P & A
	NRA 21	WOOD	WA-1-L	19 35 08	116 08 12	-125	46	6180	17.10.90	1.03.91	G & C
	NRA 22	WOOD	WA-1-L	19 35 08	116 08 12	-125	46	5230	17.10.90	12.05.91	G&C SUSP
	NRA 23	WOOD	WA-1-L	19 35 08	116 08 12	-125	46	4978	13.05.91		DRILLING
	South Pepper 12	WMC	TL/2	21 07 29	115 16 13	-18	31	2065	28.02.91	11.05.91	O

STATISTICS

PETROLEUM WELLS DRILLED

Class	Name	Operator	Title	Latitude	Longitude	Ground Elev	KB Elev	Depth @ 30.6.91	Spud Date	Rig Release Date	Status @ 30.6.91
					Carnarvon Basin						
DEVO	South Pepper 13	WMC	TL/2	21 07 29	115 16 13	-18	31	1771	1.03.91	28.04.91	O
	South Pepper 14	WMC	TL/2	21 07 49	115 17 45	-11	28	1455	11.12.90	21.12.90	P & A
	South Pepper 15	WMC	TL/2	21 07 31	115 17 48	-11	27	1280	21.12.90	29.12.90	P & A
	Talisman 5	MARATHON	WA-8-L	19 29 47	116 55 53	-79	22	2448	13.08.90	15.09.90	P & A
	Talisman 6	MARATHON	WA-8-L	19 29 41	116 56 21	-81	22	2425	16.09.90	4.10.90	P & A
	Talisman 7	MARATHON	WA-8-L	19 29 47	116 55 54	-78	22	2451	5.10.90	9.11.90	O
EXT	Barrow F82J	WAPET	PL-1H	20 51 26	115 22 38	6	16	3495	6.09.90	27.05.91	P & A
EXTO	Cowle 2	WAPET	TP/3	21 31 25	114 58 03	-13	32	2200	2.03.91	9.04.91	O SUSP
	Griffin 3	BHP	WA-210-P	21 14 37	114 36 42	-137	18	2850	15.10.90	21.11.90	O SUSP
	Roller 4	WAPET	TP/3	21 36 47	114 56 45	-12	30	1010	31.07.90	19.08.90	O SUSP
	Yammaderry 2	WAPET	TP/3	21 29 27	114 59 20	-11	30	2090	21.01.91	26.02.91	O
NFW	Tanami 1	HADSON	EP 307	20 39 17	115 34 47	12	15	2151	8.06.91		DRILLING
NFWO	Aurora 1	MARATHON	WA-191-P	19 20 44	117 00 41	-108	22	3020	11.11.90	14.12.90	P & A
	Caretta 1	LASMO	TP/9	21 36 26	114 25 57	-22	25	1782	4.05.91	30.05.91	P & A
	Dugong 1	WAPET	L10	20 53 36	115 27 30	-7	32	1902	11.04.91	2.05.91	P & A
	Eliassen 1	BHP	WA-209-P	20 04 59	116 24 07	-58	18	2518	5.06.91	30.06.91	P&A
	Leatherback 1	LASMO	EP 342	21 41 08	114 21 55	-13	32	2258	31.05.91		SUSP
	Mawby 1A	WOOD	WA-1-P	20 13 12	116 06 12	-54	22	2100	16.01.91	8.03.91	P & A
	Minden 1	BHP	WA-210-P	20 49 30	114 43 18	-243	18	4022	31.12.90	3.06.91	P & A
	Orion 1	WOOD	WA-1-P	19 52 24	116 31 31	-69	94	1714	24.07.90	20.08.90	P & A
	Ramillies 1	BHP	WA-155-P	21 15 30	114 36 06	-136	17	3151	22.11.90	29.12.90	O SUSP
	Scindian 1	BHP	WA-210-P	21 11 34	114 41 47	-121	18	3151	28.08.90	15.10.90	G&C SUSP
	Taunton 1	WMC	TL/2	21 19 46	115 05 36	-17	27	312	27.06.91		DRILLING
	Venture 1	WAPET	WA-25-P	20 08 29	115 19 14	-67	21	3324	20.08.90	5.11.90	P & A
	Wandoo 1	AMPOL	WA-202-P	20 08 21	116 25 19	-56	77	1570	20.05.91	30.06.91	O SUSP
	West Pepper 1	WMC	TL-2	21 05 10	115 12 39	-20	30	1470	17.05.91	2.06.91	P & A
	Yodel 1	WOOD	WA-28-P	19 44 45	115 43 06	-135	25	3176	22.08.90	7.10.90	G&C SUSP
					Perth Basin						
DEV	Woodada 11	CON GAS	PL 4	29 49 45	115 08 33	40	45	2191	29.03.91	21.05.91	G SUSP
	Woodada 12	CON GAS	PL 5	29 50 27	115 07 43	34		2166	30.05.91		DRILLING
EXT	Beharra Springs 2	BARRACK	EP 320	29 28 45	115 08 37	49	56	3490	31.12.90	5.03.91	G SUSP
NFW	Barberton 1	AMPOL	EP 321	30 49 09	115 56 20	215	222	3414	21.09.90	22.10.90	P & A
	Gairdner 1	BARRACK	EP 100	30 04 17	115 08 45	175	182	2172	29.10.90	22.11.90	P & A
	Ocean Hill 1	ARROW	EP 320	29 56 13	115 23 47	213	220	3840	15.03.91	17.05.91	G SUSP
	South Yardanogo 1	BARRACK	EP 320	29 29 57	115 06 11	45	52	2350	29.11.90	26.12.90	P & A
	Yallallie 1	AMPOL	EP 321	30 26 40	115 46 16	215	222	3321	7.08.90	15.09.90	P & A

KEY

Well Classification Status

DEV	Development,onshore	O	Oil
DEVO	Development, offshore	G	Gas
EXT	Extension, onshore	C	Condensate
EXTO	Extension, offshore	SUSP	Suspended
NFW	New Field Wildcat, onshore	P&A	Plugged and abandoned
NFWO	New Field Wildcat, offshore	ALL DEPTHS AND ELEVATIONS IN METRES	

STATISTICS

PETROLEUM SEISMIC SURVEYS COMMENCED DURING 1990-91

Survey name	Permit	Operator	Commenced	Completed	Total km
		Bonaparte Basin			
90N MSS	WA-199-P	Norcen	3-Jul-90	13-Jul-90	827
Bobbie Ph II MSS	WA-128-P	WMC	30-Aug-90	2-Sep-90	740
Caspian MSS	WA-199-P	Lasmo	18-Mar-91	5-Apr-91	711
Kuhuma 1991 MSS	WA-217-P	Kufpec	26-May-91	13-Jun-91	1015
		Browse Basin			
Eliza MSS	WA-212-P	Ampol	5-Apr-91	11-Apr-91	534
SPA 3SL/90-1 PK 90 MSS	Vacant	Peko	10-Jan-91	13-Feb-91	74
		Canning Basin			
Corbett SS	EP 315	Lennard	7-Aug-90	15-Aug-90	60
Gourdon SS	EP 142	Bridge	14-Sep-90	2-Oct-90	132
Meda SS	EP 129	PetSec	7-Jul-90	19-Jul-90	100
Moorak Detail II SS	EP 330	Kufpec	22-Jul-90	25-Jul-90	28
		Carnarvon Basin			
Caretta MSS	EP 342	Lasmo	14-Nov-90	22-Nov-90	479
Echo/Dixon 3D MSS	WA-28-P	Woodside	20-May-91		6330
H90 MSS	TP/8	Hadson	8-Aug-90	26-Aug-90	558
Hawksbill MSS	EP 342	Lasmo	24-Dec-90	27-Dec-90	132
HC90A MSS	WA-155-P	BHP	22-Nov-90	9-Dec-90	1482
HC90B MSS	WA-155-P	BHP	28-Dec-90	31-Dec-90	178
Jenny MSS	WA-202-P	Ampol	5-Jan-91	12-Jan-91	525
Koolinda 5 Proj 469 MSS	TL/4	Wapet	9-Dec-90	12-Dec-90	238
Patricia Extension MSS	TP/7	WMC	13-Dec-90	13-Dec-90	49
Rachel MSS	WA-203-P	Ampol	5-Jan-91	7-Jan-91	150
Roller 3D MSS	TP/2 TL/4	Wapet	2-Sep-90	20-Dec-90	5616
South Carn'von Phase 1 SS	VACANT	Western Geo.	1-Nov-90	2-Dec-90	319
SPA 1SL.90-1 3D MSS	VACANT	Halliburton Geo.	22-Jan-91		12469
SPA 25L/90-1 MSS	WA-64-P	Halliburton Geo.	2-Nov-90	11-Nov-90	1138
SPA 4SL/90-1 MSS	W90-17	Mobil	14-Jan-91	18-Jan-91	345
		Eucla Basin			
SPA 9SL/1989-90 MSS	Vacant	JNOC	26-Aug-90	4-Oct-90	5496
		Perth Basin			
Chapman Hill SS	EP 340	Discovery	11-May-91	15-May-91	30
Korijekup SS	EP 344-5	Petroz	10-Apr-91	10-May-91	199
V90A MSS	WA-220-P	Norcen	11-Oct-90	23-Oct-90	1502
Warramia SS	EP 351	Aust Oil	19-May-91	31-May-91	89

STATISTICS

IDENTIFIED RECOVERABLE PETROLEUM RESERVES AT 30 JUNE 1991

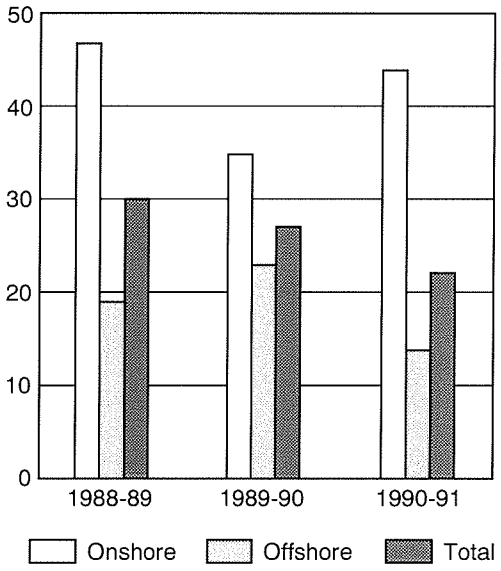
	OIL C_{7+} (10^6kL)		GAS C_1-C_4 (10^9m^3)		CONDENSATE C_5+C_6 (10^6kL)	
Status						
Probability of recovery	90%	50%	90%	50%	90%	50%
Proved (Developed)						
Barrow Island	7.027	8.109	0.302	0.302		
Beharra Springs			0.447	0.543		
Blina	0.107	0.221				
Boundary	0.001	0.001				
Chervil	0.172	0.172	0.051	0.051		
Cowle	0.065	0.065				
Dongara #	0.028	0.028	0.606	0.606		
Harriet	3.201	3.208	1.217	1.217		
Lloyd	0.001	0.001				
Mt. Horner	0.073	1.328				
North Herald	0.234	0.234				
North Rankin			148.260	169.160	15.462	18.762
Rosette	0.016	0.016	0.297	0.420	0.054	0.076
Saladin	1.177	3.224	0.076	0.210		
South Pepper	0.316	0.530				
Sundown	0.016	0.016				
Talisman	0.105	0.105	0.002	0.002		
West Terrace	0.001	0.001				
Woodada			1.104	2.464	0.007	0.017
Yammaderry	0.023	0.105				
TOTAL	**12.563**	**17.364**	**152.362**	**174.975**	**15.523**	**18.855**
Proved (Undeveloped)						
Bambra	0.015	0.015	0.334	0.644	0.039	0.048
Campbell			1.198	1.896	0.162	0.252
Chinook		1.552		0.460		
Cossack	8.200	13.200				
Goodwyn Main		1.000	95.200	107.300	36.400	42.100
Griffin		12.991				
Ramillies		0.126				
Roller	0.507	1.209	0.006	0.014		
Scindian		2.019		0.210		
Sinbad			0.674	1.505	0.110	0.245
Tubridgi			2.140	2.160		
Wanaea		23.100		4.100		
TOTAL	**8.722**	**55.212**	**99.552**	**118.262**	**36.711**	**42.645**
Probable						
Angel				42.100		12.500
Dockrell						
Echo-Yodel				8.500		5.700
Egret						
Goodwyn South						
Lambert						
North Rankin W				7.000		0.800
Tidepole		0.300		11.600		3.200
Wilcox				8.600		3.400
TOTAL		**2.300**		**77.800**		**25.600**
TOTAL RESERVES	**21.285**	**74.876**	**251.914**	**371.037**	**52.234**	**87.100**

#: Includes Dongara, Mondarra and Yardarino Fields.

STATISTICS

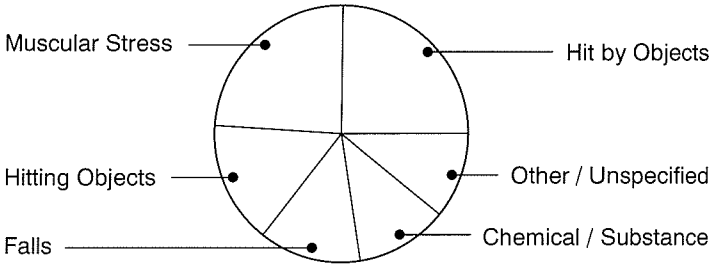
PETROLEUM INDUSTRY ACCIDENTS

Accident Frequency

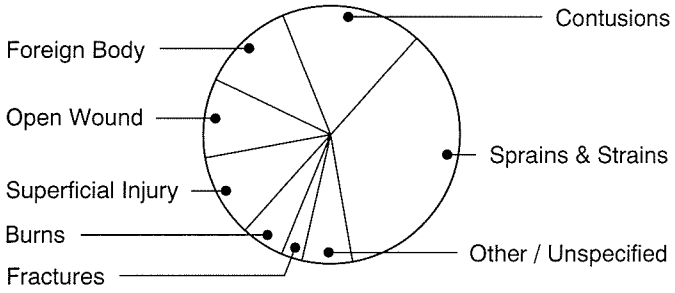


Lost-time accidents / million hours worked

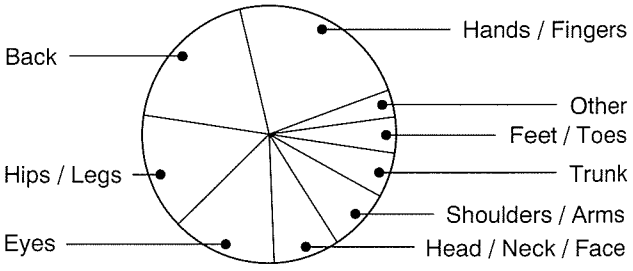
Type of Accident



Nature of Injury

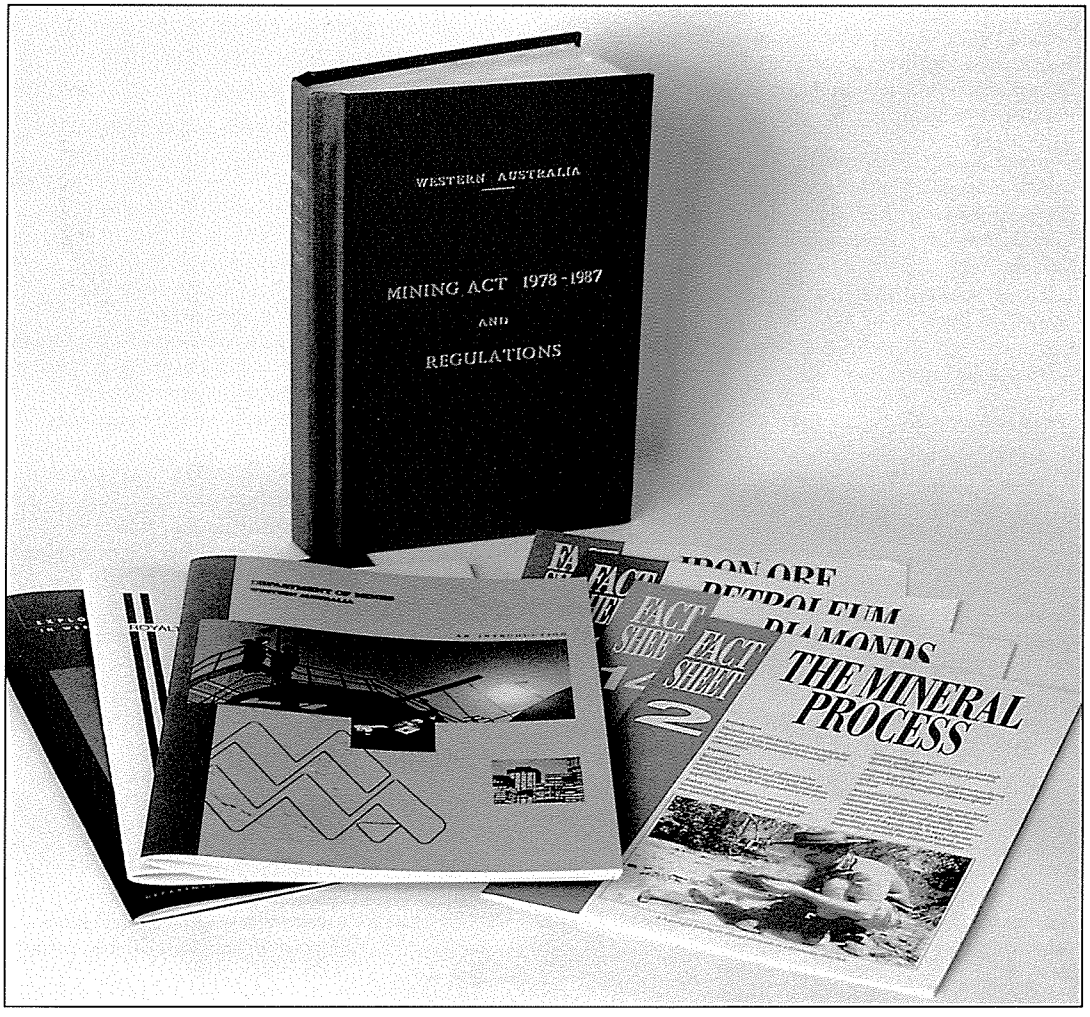


Part of Body



APPENDICES

ANNUAL REVIEW



APPENDIX 1

LEGISLATION

The Department is responsible to the Minister for Mines for the administration of 17 individual Acts of Parliament. These include:

Mining Act
Mines Regulations Act
Petroleum Act
Coal Mines Regulation Act
Coal Miners' Welfare Act
Explosives and Dangerous Goods Act
Mines Regulation Act
Mine Workers' Relief Act
Miners' Phthisis Act
Mining on Private Property Act
Petroleum Pipelines Act
Petroleum (Registration Fees) Act
Petroleum (Submerged Lands) Act
Petroleum (Submerged Lands) Registration Fees Act
Western Australian Coal Industry Tribunal Act

The following Commonwealth legislation is administered by the State through the Commonwealth/Western Australian Offshore Petroleum Joint Authority:

Commonwealth Petroleum (Submerged Lands) Act
Commonwealth Petroleum (Submerged Lands) (Registration Fees) Act
Commonwealth Petroleum (Submerged Lands) (Royalty) Act
Commonwealth Petroleum (Submerged Lands) (Retention Lease Fees) Act
Commonwealth Petroleum (Submerged Lands) (Exploration Permit Fees) Act
Commonwealth Petroleum (Submerged Lands) (Production Licence Fees) Act
Commonwealth Petroleum (Submerged Lands) (Pipeline Licence Fees) Act
Commonwealth Minerals (Submerged Lands) (Registration Fees) Act 1981
Commonwealth Minerals (Submerged Lands) (Works Authority Fees) Act 1981
Commonwealth Minerals (Submerged Lands) (Production Licence Fees) Act 1981
Commonwealth Minerals (Submerged Lands) (Exploration Permit Fees) Act 1981
Commonwealth Minerals (Submerged Lands) (Royalty) Act 1981

In addition to its responsibilities under the above Acts, the Department undertakes various functions in relation to a number of special Agreement Acts:

Barrow Island Royalty Trust Account Act
Barrow Island Royalty Variation Agreement Act
Mining (Validation and Amendment) Act.

The following Acts previously administered by the Department are now administered by the Coal Industry Superannuation Board:

Coal Industry Superannuation Act 1989
Coal Mining Industry Long Service Leave Act.

CHANGES TO LEGISLATION

Mines Regulation Act 1946 and Regulations

The Mines Regulation Amendment Regulations 1991 were gazetted on 15 February 1991. These regulations amended Part 9 of the Mines Regulation Act, which encompasses protection of miners against noise induced hearing losses.
The Mines Regulation Act, Regulation 2.7 was repealed on 15 March 1991 abolishing the District Inspectors of Mines Selection Committee.

Coal Mines Regulations

The Coal Mines Amendment Regulations 1991, Regulation 21 was amended on 21 June 1991 to increase the fee for management certificates .

Petroleum — State Legislation

During the year the Petroleum Act 1967, the Petroleum (Submerged Lands) Act 1982 and the Petroleum Pipelines Act 1969 were amended by **Acts Amendment (Petroleum) Act 1990.** Similarly, the Petroleum (Registration Fees) Act 1967 and the Petroleum (Submerged Lands) Act 1982 were amended by the **Petroleum (Registration Fees) Amendment Act 1990** and the **Petroleum (Submerged Lands) Registration Fees Amendments Act 1990.** Further, the Petroleum Regulations 1987 was amended by the **Petroleum Amendment Regulations 1990.** All of these amendments were gazetted on 28/9/90.
These amendments generally reflect amendments made to the Commonwealth Petroleum (Submerged Lands) Act, 1967 to preserve the common mining code envisaged by the 1979 Offshore Constitutional Settlement between the Commonwealth and the States, but modified to make good various discrepancies and additional improvements. The following changes were made:

- Provision for explorers to retain tenure over presently noncommercial discoveries by way of retention leases;
- Streamlining of the registration procedures for legal documents;
- Clarification of the the extension and scope of access and special prospecting authorities to facilitate increased seismic acquisition;
- Provision for earlier release of basic data and interpretive information supplied by title holders;

APPENDIX 1

LEGISLATION

- Provision for the service of documents on two or more title holders to be made to a common address;
- Provision for production of petroleum to occur through a surface installation outside a production licence by way of a deviated well;
- Nomination of blocks as a location (the forerunner of a production licence or retention lease) to conform to the boundaries of a field rather than the present artificial nine block square;
- Peripheral facilities, particularly of a minor processing nature, being adopted into an onshore pipeline;
- Pipelines in the internal water areas of the State (including all of the Barrow Island loading line) being brought under the jurisdication of the Petroleum (Submerged Lands) Act of WA; and
- The Crown Land definition in the Petroleum Act being expanded to align with the Crown Land definition under the Mining Act.

Also during the year the Petroleum Act 1967 was further amended by the **Petroleum (Drilling Reservations) Amendment Act 1990** which was gazetted on 22/2/91 to allow for the granting and administration of drilling reservation titles.

Petroleum Amendment Regulations 1991

It was gazetted on 28/6/91.

- Its purpose was to amend forms to mirror and reflect the same fees prescribed for Petroleum Exploration Permit.

Petroleum — Commonwealth Legislation

Two petroleum-related acts — the Commonwealth Petroleum (Submerged Lands) Act 1967 and the Commonwealth Petroleum (Submerged Lands) (Royalty) Act 1967 — that the Department jointly administers with the Commonwealth Government were amended during the year. The amended Acts were the:

Petroleum (Submerged Lands) Amendment Act 1991, and

Petroleum (Submerged Lands) (Royalty) Amendment Act 1991 which commenced on 25/6/91. They:

- Provide for the delegation of routine Joint Authority powers jointly to Commonwealth and State officials.
- Clarify the basis for royalty transfers between Commonwealth and Western Australia.
- Extend the period of confidentiality for basic speculative survey data up to five years at the designated Authority's discretion.
- Provide mandatory insurance and abolish securities.

The Explosives and Dangerous Goods Act 1961 was amended by the **Explosives and Dangerous Goods (Third Schedule) Amendment Order 1990.**

This amendment to the Third Schedule to the Act was necessary to correct a deficiency in the classification of flammable liquids and to include some substances in the Poisons Act as Chronic Hazardous Substances. The amendment also saw a changeover to the alphabetical classification system for Restricted Dangerous Goods.

Explosives and Dangerous Goods (Classification of Dangerous Goods) Amendment Order 1990.

This amendment was required to declare particular substances to be dangerous goods and to classify those substances by reference to the system specified in the Third Schedule to the Act.

Explosives and Dangerous Goods Amendment Act 1990

This amendment Act was assented to on 27 September 1990 and proclaimed on 23 November 1990.

Many of the changes detailed in the Bill were necessary for the implementation of the requirements of the Public Safety Sub-Committee through the Dangerous Goods Regulations.

Other changes included an increase in the penalty provisions of the Act and streamlining of some of the general administrative processes.

Mining Amendment Act 1990 (No.22/90)

This Amendment Act was proclaimed to operate from June 28, 1991. The major highlights of these amendments are:

- ***Graticular System for Exploration Licences***

This system provides for exploration licences to have boundaries defined by lines of predetermined latitudes and longitudes, one minute by one minute. Each one minute block has its own identification number.

The boundaries of exploration licences are now described using this system and up to 70 blocks may be applied for.

- ***New provisions relating to mining tenements over townsites***

New Section 26A allows the Minister for Mines to request the holder of a tenement over a townsite to surrender the surface (up to 15 metres) of part or all of the tenement for community purposes if the surrender is not lodged within 30 days, the land is deemed surrendered.

- ***Conditions for prevention or reduction of injury to land***

New Sections 46A and 63AA allow reasonable environmental conditions to be imposed on prospecting and exploration licences at any time to ensure maximum environmental protection allowable should circumstances change.

APPENDIX 1

LEGISLATION

■ ***Surrender of certain areas subject to the exploration licence***

Section 65 has been amended to clearly state that a surrender under this section must be lodged on or before the expiry of the third or fourth year of the licence term.

■ ***Miscellaneous licences***

New Sections 94A and 94B allow for mining tenements to be applied for and granted over land the subject of a miscellaneous licence.

■ ***Exemption from expenditure conditions***

An application for exemption may now be lodged during the year to which the expenditure relates or within 60 days thereafter. The same period that applies to the lodgement of the Form 5 Report on Operations.

■ ***Verification of royalties payable***

Section 109A was inserted to enable the Minister for Mines to make an estimate of royalty where royalty has not been paid, or was not properly assessed or calculated, and to accept audit certificates as verifying royalty. It also allows for the production and inspection of records relating to the verification of royalties and includes penalties for persons failing to supply the information required to enable assessment of royalties.

■ ***Increase of various monetary penalties***

Monetary penalties relating to breach of tenement covenants or conditions and various offences have been substantially increased to act as a deterrent and to provide a meaningful alternative to forfeiture of a tenement where that is provided for.

Mining Act 1978 Regulations

Mining Amendment Regulations (No. 4) 1990, gazetted November 16, 1990.
To provide for new marking out procedures.
Mining Amendment Regulations 1991, gazetted May 31, 1991 to operate from June 28, 1991.
These regulations support the graticular section system for exploration licence boundaries contained in the Mining Amendment Act 1990 (No. 22.90).
Mining Amendment Regulations (No. 2) 1991, gazetted May 24, 1991.
Includes meteorological station and sulphur dioxide monitoring station as prescribed purposes for which a miscellaneous licence can be applied for.
Mining Amendment Regulations (No. 3) 1991, gazetted June 21, 1991 to operate from July 1, 1991.
To provide for a user pays survey system for leases.

APPENDIX 2

RESEARCH & DEVELOPMENT PROJECTS

Chemistry Centre (WA)

■ *Commenced and Continuing*

Alkaloid Content in Lupin Plants.
Alkaloid Levels in Commercial Lupinseed.
Alkaloids and Protein in Lupin Breeding Samples.
Purification of Lupin Alkaloids.
Arsenic Contamination of Wool.
Cadmium in Vegetables.
Non Wetting soils Cause of Hydrophobicity.
Vasse Wonnerup Soil Survey.
Vegetable Production and Water Pollution.
An Investigation of Salt Induced Stains of Swimming Pools.
The Causes of Corrosion in a Hospital Calorifier.
Efficacy Assessment of Two Swimming Pool Algicides.
Causes of Corrosion in a Large Hospital Chilled Water System.
Determination of Radon in Waters.
Joint Investigation With Health Department into Organochlorine Pesticide Residues in Human Breast Milk. (Series 2).
Survey of Pesticide Residues in Fruit and Vegetable Marketed in Western Australia.
Investigation of Pesticide Contamination of Fish in the Swan River.
Investigation into the Effect of Air Conditioner Cooling Water Discharges from the Central Business District, Perth, WA, on the Swan River.
A Survey (with Health Department) of Metropolitan Perth Tip Leachate Contamination of Groundwater.
A Joint Investigation with Environmental Protection Authority in the Quality of the Perth Atmospheric Environment with Respect to Hydrocarbon Contamination.
Synthesis of Deuterated Pethidine and Norpethidine.
Extraction and Analysis of Salbutamol.
Screening of Basic Drugs by Photodiode Array/HPLC.
Blood Alcohol Concentration of Preserved Versus Non Preserved Post Mortem Bloods.
Fluoride Levels in Post Mortem Bloods.
Solid Phase Extraction of Drugs.
Determination of B-Blockers by GC/MS Using Boronic Acid Derivatisation.
Screening of Benzodiazepines by Photodiode Array/HPLC.
Brass Particle Analysis.
Organic Pigment Identification in Automotive Paints.
Characterisation of Metallic Detonator Fragments.
Characterisation of Lipsticks by Pyrolysis Technique.
Alcohol Metabolism Studies.
Comparison of Microscopic Toolmarks by SEM.
Survey of Waste Anaesthetic Gases in Western Australian Hospitals.
Feasibility Study of a New Face Mask for Scavenging Waste Anaesthetic Gases from Recovery Patients.
Method for the Determination of Oxalates in Air.
Feasibility Study on Microwave Digestion on Biological Materials for Arsenic Determinations.
Development of Isocyanate Method and Survey for Industries.
Method for the Determination of Patulin in Apple Juice.
Survey of Lead in Wine Crystal Glasses.
Testing the Calibration of Hydrogen Cyanide Monitors Using Standard Gas Concentrations.
Method (Colorimetric) for the Determination of Cyanide in Blood
The Effects of Storage Time on the Concentrations of Additives in Meat.
Mercury in Western Australian Shark.
Mycotoxins: A Preliminary Report.
Sulphur Dioxide in Western Australian Foods.
Cadmium in Potatoes.
MERIWA Project: Studies on the Column Flotation Characteristics of Oxide and Sulphide Ores.
Comparative Study of Gold Assays in Complex Sulphide Materials by Fire Assay and Aqua Regia Digest/AAS.
Effect of Wetting and Oxidizing Agents on Heap Leaching of Gold Ores.
Comparison of XRD and FTIR Methods of Quartz Dust Analysing Using Direct and Indirect Sample Preparation.
Quantitation of Respirable Silica by FTIR Spectroscopy.
Analysis of Historical Leather by FTIR Spectroscopy.
AMIRA project: Fate of Cyanide near Mine Tailings Involving Speciation and Quantification of Metal Cyanide Complexes.
Automated Gold Search Routine Using the Scanning Electron Microscope.
Modified Bond Work Index Procedure.
Calcium Fouling of Activated Carbon used for Gold Recovery.
Pressure Oxidation of Stibnite to Enhance Gold Extraction.
NPDP Sponsored Project: On Line Metal Analyser for Mineral Processing (Jointly with Chemtronics Ltd).
Carbon Attrition in Pulp Method Development.
Grefco Filtration Standard Method for Diatomite.
Friability of Ilmenite During Upgrading.
The Determination of Selenium in Gold Bullion by ETA. AAS.
The Speciation of Silicon and Quantification by XRF.
Furnace Efficiency Studies on the Electronic Carbon Arc Silicon Smelter: Joint Project with SIMCOA and Curtin University.
Characterisation of Silica Fume By-product from the Silicon Smelter : Joint Project with SIMCOA and Curtin University.
Petrogenesis of Stratiform Barite : Joint Project with Geological Survey (WA).

APPENDIX 2

RESEARCH & DEVELOPMENT PROJECTS

Mineralogy, Mineral Chemistry and Geochemistry of Gold Bearing Sulphide Facies Iron Formation: Joint Project with Geological Survey (WA).
Mineralogy of Oxidised Green Leader and other Telluride Iodes.
Featurescan Software Development to Automatically Quantitate Low-level Gold in Stibnite Concentrates.
Software Development to Automatically Characterise the Size of Airborne Dust in the Mineral Sands Industry : Joint Project with Mining Engineering Division.
The Development of an on-line Hydride Generation Device for ICP-AES.
Detection of Corticosteroids by GC-MS.
Detection of Anabolic Steroid Metabolites in Greyhounds.

■ *Completed*

Installation and Commissioning of a Inductively Coupled Plasma Atomic Emission Spectometer. (External Funding for half cost).
Installation and Commissioning of Leco Nitrogen Determinator. (Externally Funded)
Installation and Commissioning Graphite Furnace Atomic Absorption Spectrometer
Ionic Strength of Western Australian Soils.
Alkaloid Profiles in Lupinus Species.
Soil Test Subsoil Aluminium Extractable in .005M KCl.
Investigation and Minimisation of Corrosion Factors Associated with the Southern Cross Fountains (Narrows Interchange).
The Determination of Copper at Trace Concentration in Petrol.
The Determination of Aluminium at Ultratrace Concentrations in Water.
Survey of Inorganic Constituents in 60 Commercially Available Mineral Waters.
Investigation into the Agriculture Protection Board's Fenithrothion/Locust Control Program.
Joint Investigation with the Health Department into Organochlorine Pesticide Residues in Human Breast Milk.
An Investigation into Tailings Management Practices at a Gold Mine Site in South Western Australia.
An Investigation into Residue Disposal Practices at an Aluminium Smelting Plant at Port Henry, Victoria.
Two major surveys of Groundwater Quality for Organic Chemical Contamination (Jointly with WAWA).
Blood Alcohol Management System.
Screening of Acidic and Neutral Drugs by HPLC.
Deuterated Standards in Drug Analysis.
Automatic Gunshot Residue Particle Analysis.
Forensic Applications of Simultaneous Pyrolysis/Alkylation.
Development of a Fuel Cell Powered Breath Analyser Device.
Selection of Containers for the Storage of Organochlorine Pesticides in Blood.
Effectiveness of a Fume Cupboard with a New Filter System.
Feasibility Study of a Recirculating Prototype Fume-cupboard for Usage in Western Australian Schools.
Study of the Effectiveness of a New Scrubbing System for Fumecupboards at Tiwest, Kwinana.
With Health Department, set up Standard Criteria for Procedures in Hospital X-ray Photograph Laboratories involving Chemicals.
Method for the Determination of Lead in Blood by GFAA.
Method for the Determination of Thallium in Urine by GFAA.
Method for the Determination of Selenium in Blood.
Method for the Determination of Cyanide in Blood by HPLC.
Method for the Determination of Mercury in Charcoal Tubes.
Method for the Determination of Arsenic in Blood and Urines.
Heap Leaching Characteristics of Western Australian Gold Ores.
Separation of Arsenopyrite and Pyrite from Harbour Lights Gold Mines Concentrates.
Bubble Size Measurements in Two and Three Phase Systems in Column Flotation.
Ferric Chloride Leaching Characteristics of Copper Concentrates.
Photodegradable Shopping Bags.
Photodegradable Polyethylenes (Student project)
Silicon Based Polymers from Silica Fume - Student project.
High Purity Silica from Silica Fume - Student project.
Determination of Active Xanthate.
The Effect of Water Temperature and Water Hardness on Flotation of Mt Weld Phosphate Ore (Jointly with CSIRO).
The Determination of Trace Level Impurities in Platinum Metal by ICP-AES.
The Development of a Simple on-line Dilution Device for ICP-AES.
The Quantitative Retention of Sulfur in a Lithuim/lanthanum Borate Flux for XRFs Analysis.

Explosives and Dangerous Goods

The Explosives and Dangerous Goods Division is involved in the development of total hazard control plans for major industrial sites in the State.

Geological Survey

Most of the work of the Geological Survey Division is involved in research and development projects to investigate, interpret and record the geology of Western Australia; relate the mineral, petroleum and groundwater occurrences and potential to that geology; and evaluate the mineral, fossil fuels and groundwater resources of the State. For a full listing

APPENDIX 2

RESEARCH & DEVELOPMENT PROJECTS

Explosives and Dangerous Goods

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Pilbara Craton geological mapping;

King Leopold and Halls Creek Orogens geological mapping;

Geoscientific investigations in the Eastern Goldfields region;

Paterson Orogen geological mapping;

Jurassic sequences of the southern North West Shelf;

Basin studies in the northern Perth Basin;

Seismic-horizon mapping in Phanerozoic basins

Perth Basin groundwater vulnerability map

Geotechnical studies relating to mining; and

Hydrogeological studies relating to land-use.

Mining Engineering

■ *Completed*

Asbestos Management Guidelines.

Guidelines for Environmental Damage Repair - auditing, bond release and related tendering procedures.

Radon Survey of Underground Mines.

■ *Commenced and Continuing*

Survey of asbestos fibres in underground nickel operations.

Blast and environmental noise monitoring program in Kalgoorlie.

Procedures for repairs, modifications and inspections of classified machinery.

Tyre handling manual.

Guidelines for design of headframes and mining structures.

Design and operational standards for tailings dams.

Review of the existing guidelines relating to notice of intent preparation.

Statistical analysis of AXTAT and CONTAM data.

Guidelines for noise control in mines.

Petroleum

■ *Completed*

Reservoir engineering studies on fields including Saladin, Rosette, Griffin and Chinook.

Petrophysical appraisal of wells drilled particularly where hydrocarbons have been encountered.

Potential for recovery of associated gas from oil producing operations on the North West Shelf.

Surveys and Mapping

■ *Completed*

Geographic Informaton System (GIS) strategic plan implemented with the purchase and installation of a Unix workstation and ARC/INFO software package.

North Perth Basin Land Information System database.

90 computer plots generated for ongoing analysis and evaluation of resource and environmental information.

Graphical Digital Database: development of a database for EPA System 5, 7, 8 and 9 to facilitate ongoing analysis and evaluation of resources and environmental information.

■ *Commenced and Continuing*

MINEDEX: the location and plotting of all mineral resource and mining industry sites.

The use of geographical information systems is being examined in the Hamersley Range project study to provide a resource strategy for rational, long-term development of the Pilbara iron ore industry.

Computer assisted map production pilot study of geological mapping has advanced to a four colour electrostatic paper copy proof stage and requires only the production of plate-ready negatives to complete the assessment.

Global Positioning Systems: Field testing, post-processing and demonstrations for mining tenement boundary delineation and mapping control is ongoing to enable the development of specifications and guidelines for the use of the equipment.

The capture, examination, certification and integration of all surveyed mining tenement boundaries.

TENGRAPH: an electronic public plan replacement for the current analog system. It will show the position of mining tenements and other land information and allow for the receival of tenement applications and appraisals.

APPENDIX 3

PUBLICATIONS

The Department produces a wide range of publications designed to meet the diverse needs of all divisions.
These publications are, in the main, either informative or technical and serve all levels of the community from basic information for the general public and school children to all levels of the mining and petroleum industry and Government.
On occasion the Department produces promotional literature to increase public awareness of the importance of the State's mining industry and the diverse role of the Department in its managment on the community's behalf.

Chemistry Centre (W.A.)

■ ***Technical***

Agricultural Chemistry Laboratory

Distribution of Alkaloid Levels at Two Western Australian Lupin Receival Points. D J Harris, Poster Paper, 6th International Lupin Conference, Chile, Pucon, November 1990.
An enzyme-linked Immunosorbent Assay (ELISA) for Lupin Alkaloids : Comparison with Gas Chromatography. D G Allen, B N Greirson, D J Harris, Poster Paper, 6th International Lupin Conference, Chile, Pucon, November 1990.
Cadmium and Lead Content of Western Australian Commercial Lupin Seed. D J Harris, B L Youngberg, D S Petterson (WADA), Poster Paper, 6th International Lupin Conference, Chile, Pucon, November 1990.
The Effect of Processing on the Mineral Content of Lupin Seed. D J Harris, P Coates, D S Petterson (WADA), Poster Paper, 6th International Lupin Conference, Chile, Pucon, November 1990.
Phosphate and Sulphate Adsorption Properties of Soils from the Coastal Plain of Southwest Western Australia. D G Allen, R C Jeffery, R D'Ercole, Occasional Publication Agricultural Chemistry Laboratory, June 1991.
Chapter entitled Alkaloids, in the book Toxic Substances in Crop Plants D S Peterson (WADA), D J Harris, D G Allen (Royal Society of Chemistry, London) in press.
Reference Soils of South-Western Australia. Australian Society of Soil Science (WA Branch) in press.

Environmental Chemistry Laboratory

Guidelines for the Metal Finishing Industry S Smith, G Ho, P Ryan, N Davies, P Hoar, R S Schulz, AWWA 14th Federal Convention, Perth, March 1991.
Investigation of Chemical Control of Peel Harvey Eutrophication. A J Hendry and R D Taylor, Chemistry Centre Report, July 1990.
Trace Organic Analyses in Waters. D J Ingraham to an Interdepartmental Workshop at the Water Authority of Western Australia, June 1991.
Analytical Aspects of PCB Analysis. G F Ebell, RACI Environment Trave Organic Analysis Workshop, May 1991.
Analysis of Polynuclear Aromatic Hydrocarbons Using GC/MS Methodology R J Hart, RACI Environment Trave Organic Analysis Workshop, May 1991.

Forensic Science Laboratory

Detection of Petrol Residues in Human Viscera by Curie Wire Pyrolysis Gas Chromatography Mass Spectrometry - Select Ion Monitoring. R C Hansson, 27th Meeting of the International Association of Forensic Toxicologists, Perth 1990.
The Effects of Petrol Sniffing on the Brain (Lead Encephalopathy). K A Margolius, R A Timms, C Kaelen and R C Hansson, 27th Meeting of The International Association of Forensic Toxicologists, Perth 1990.
Toxicology Screening. P A Collins, R C Hansson and T Horsten, 27th Meeting of The International Association of Forensic Toxicologists, Perth 1990.
Detection and Identification of Acidic/Neutral Drugs. T Horsten, 27th Meeting of The International Association of Forensic Toxicologists, Perth 1990.
Urinary Excretion of Cannabinoids. C R Priddis and S G Kailis, 27th Meeting of The International Association of Forensic Toxicologists, Perth 1990.
Blood Alcohol Estimation Using Passive Breath Samples and Fuel Cell Based Breath Alcohol Analysers. D Honey, Meeting of The International Association of Forensic Toxicologists, Perth 1990.
Cannabis and Driving Offences - Is There A Case for a Prescribed Level? N T Campbell, Conference of Police Personnel Engaged in Breath Analysis. Perth 1990.
Assessment of the Alcotch AR 1005 Breath Alcohol Analyse. D J Honey, Conference of Police Personnel Engaged in Breath Analysis, Perth 1990.
The Effect of Ventolin on Apparent Blood Alcohol Levels as Measured By The Drager Alcotest 7110 Breath Alcohol Analyser. D Honey, Conference of Police Personnel Involved in Breath Testing, Perth 1990.
Evaluation of an Automated Gunshot Residue Detection System. B Lynch and D Honey, Meeting of IAFS, Adelaide, October 1990.
Drugs and Driving - The Western Australian Experience 1985-90. N T Campbell, Meeting of IAFS, Adelaide, October 1990.
The Application of a Modified Carbon Wire Adsorption Solvent Extraction Technique to the Analysis of Accelerant and Volatile Organic Compounds in Arson Debris. D Tranthim-Fryer, Meeting of IAFS, Adelaide, October 1990.
Latest Developments in the Use of Simultaneous Pyrolysis Methylation for the Identification of Crime Scene Evidence. J Challinor, Meeting of IAFS, Adelaide 1990, October.

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PUBLICATIONS

Identification and Analysis of Trimethylbiphenyl in Petroleum. R Alexander, S H Ngo and R I Kagi, Journal of Chromatograph 538 (1991) 424-30.
A Fatal Case Involving Aldicarb. S H Ngo, TIAFT Bulletin Volume 21(2) p 29-32.
A Fatal Case Involving Phenelzine and Amitriptyline. R C Hansson, TIAFT Bulletin Volume 20 (3), p 14-17.
Gunshot Residue Detection. B Lynch, Talk to Western Australian Society for Electron Microscopy, July 1990.
Explosive Residue Detection. B Lynch, Talk to Bomb Scene Examiners Course, August 1990.

Health Chemistry Laboratory

Monosodium Glutamate in Western Australian Foods. An Interdepartmental Report as part of the Western Australian Food Monitoring Program, August 1990.
The Determination of Thallium in Urine By Zeeman Graphite Furnace Atomic Absorption Spectrometry. S M Jones and D N Collett, Atomic Spectroscopy (in print).
The Simultaneous Determination of Hippuric Acid And Creatinine In Urine By Liquid Chromatography. M Hoare and F Ferrante, Chemistry In Australia (in print).
A Study Into The Use of Urinary Creatinine and Fluoride Levels as an Indicator of Community Exposure to Low Level Atmospheric Contaminants. M B Rowe, Proceedings 9th Annual Conference of Australian Institute of Occupational Hygienists, Perth, 1990.

Kalgoorlie Metallurgical Laboratory

Pre-reduction of Manganese Ore for Ferromanganese Smelting. V N Misra, Minerals, Materials and Industry, Proceedings of 14th Metallurgy, Edinburgh, Scotland, 2-6 July 1990, pp. 38-48.
Studies On The Flotation Of Mixed Oxide Sulphide Ores of Copper From Malanjkhand Deposit V N Misra et al, Mineral, Materials and Industry, Proceedings of 14th C.M.M.I., The Publication of I.M.M., Edinburgh, Scotland, 2-6 July 1990, pp. 367-374.
Studies On The Heap Leaching Characteristics of Western Australian Ores. V N Misra, R E Browner and J H Kyle, Proceedings of World Gold '91, Aus. I.M.M. & S.M.E. Publications, Cairns, 21-25 April 1991, pp. 219-222.
Determination of Gold and Silver in Activated Carbon by AAS. B C Das, Aus. I.M.M. Bulletin (in print).

Materials Science Laboratory

Glaze Faults In Ceramic Floor Tiles. G M Ferguson, Austceram '90 International Symposium, Perth, February 1990.
Photodegradable Shopping Bags - Environmental Hazard or Blessing? G M Ferguson, IUPAC/RACI Polymer Division International Symposium, Melbourne, February 1991.
Biodegradation of Synthetic Polymers. G M Ferguson, Chemistry in Australia 58(1), January 1991.
Photodegradable High Density Polyethylene - Based Shopping Bags - Environmental Hazard or Blessing? G M Ferguson, Polymer International, June 1991 (in Print).
Analysis of Waterlogged Leather using Fourier Transform Infrared Spectroscopy - A Preliminary Study. G W Richardson and I Godfrey, Australian Institute for the Conservation of Cultural Materials, Tasmania, July 1990.
Black Prosthesis Revisited: A Study of Epinephrine - Induced Pigment Deposits on Poly (Methyl Methacrylate). T Chirila, R Cooper, I Constable, G Richardson, S Vijayasekoran, British Journal of Ophthalmology (in Print).

Mineral Processing Laboratory

Cyanide in Gold Mine Tailings - Interaction of Cyanide With Soils. K Jones and W P Staunton, Proceedings Randol Gold Forum - Managing the Mine and Mineral Processing Environment, Cairns Qld, 16-19 April 1991.
Roasting and Cyanide Leaching of a Gold Bearing Pyritic Concentrate From Kalgoorlie. J Avraamides, G Nguyen, J Dunn and J Graham, Proceedings World Gold '91 Joint Aus I.M.M. SME Conference, Cairns Qld, 21-23 April 1991, p45-53.
Prospects For The Direct Leaching of Gold Telluride-Recent Developments. J Avraamides, I M Ritchie and S Jayasekera, Proceedings World Gold '91 Joint Aus I.M.M. SME Conference, Cairns Qld, 21-23 April 1991, p181-183.
Reduction of Vicinal Dihalides, II Leaving Group Effects On The Electrochemical Reduction of 1, 2-Dihalo-1, 2-Diphenylethanes and 1, 2-Dihalocyclohexanes. J Avraamides, P Fawell and G Hefter, Australian Journal of Chemistry 44, 1991 p791-798.
Upsurge In Thermal Processing - Review Of Pyrosem WA, Seminar on Pyrometallurgical Operations. J Avraamides, The Miner, June 1991, p16.
Characterisation of Cyanide Species in Mill Solutions. K Jones, J McGuire and W P Staunton, Processing Aus I.M.M. Seminar CIP/CIL Plants - Problems and Answers, Kalgoorlie, 21 March 1991.
Pyrometallurgy Testing and the Chemistry Centre (WA). T O'Brien, Proceedings: Pyrosem WA - A Seminar On Pyrometallurgical Operations In Western Australia, Aus I.M.M., Murdoch University, Perth, 9 November 1990, p126-138.

Mineral Science Laboratory

Rare Earth Deposits In A Deceased Movie Projectionist. A New Case of Rare Earth Pneumoconiosis. P M Waring, R J Watling, Medical Journal of Australia 153, 726, December 1990.

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PUBLICATIONS

Thermospray Interface For High Performance Liquid Chromatography - Diffuse Reflectance Fourier Transform Infra-red Analysis R J Watling et al, Analytical Proceedings 28, 8, January 1991.
Stable Isotopes and Fluid Processes in Mineralisation. H K Herbert and S E Ho, Geological Department University Extension, University Western Australia, Publ. 23, 382, 1990.
Sodium Bicarbonate-Rich Brines, Denison Trough: Potential Ore Fluids in Bowen Basin? H K Herbert and H R Krouse, Symposium: Geological Society Australia, 1990.
The Hydrogeology and Speleology of Yanchep. L V Bastian, Proceedings of the Australian Speleological Federation, January 1991.
Sorting Out Old Yanchep Cave Discoveries. L V Bastian, The Western Caves, Vol 30 1990.
Newly Indexed Caves and Entrances in Yanchep National Park. L V Bastian, The Western Caver, Vol 30 1990.
Mineralogical Analysis of Concretes. R M Clarke, (Proceedings) RACI Polymers and Building Technology Seminar, Perth, May 1990
The Significance of Asbestos Cement Building Products As A Source Of Airborne Asbestos. R M Clarke, Australian Institute of Occupational Hygienists Conference, December 1990.
Advantages of State-Of-The-Art Computer Controlled SEM for Measuring Environmental Asbestos Concentrations. R M Clarke and G Horsley, (Poster Presentation), Australian Institute of Occupational Hygienists, December 1990.
Advantages Of A State-Of-The-Art Computer Controlled SEM System For Measuring Environmental Asbestos Concentrations. R M Clarke and G Horsley, 9th Annual Conference of Australian Institute of Occupational Hygienists, Perth, December 1990.

Racing Chemistry Laboratory

Detection Of Triamcinolone Acetonide in Equine Urine. J M Ralston and A M Stenhouse, 27th Meeting of the International Association Of Forensic Toxicologists, Perth, October 1990.
Salicylic Acid Concentrations in Urine From Horses Raced in Western Australia. A M Stenhouse, S Redhead and J M Ralston, 27th Meeting of the International Association Of Forensic Toxicologists, Perth, October 1990.
Detection of Heptaminol and Amphetamine type Drugs Using GC-MS in Negative Ion Chemical Ionisation. C I Russo and S B Black, 27th Meeting of The International Association Of Forensic Toxicologists, Perth, October 1990.
The Use of Scintillation Proximity Assay (SPA) Reagent in Immunoassay. G J Buck, S F Lucks and A M Stenhouse, 27th Meeting of the International Association Of Forensic Toxicologists, Perth, October 1990.

Explosives And Dangerous Goods

■ ***Informative***

Notes for the Shotfirer
Summary of Accident Reports
Numerous guideline documents on many aspects of the Explosives,Flammable Liquids, Dangerous Goods (Road Transport) Regulations and Risks and Hazards.
Explosay - Quarterly divisional newsletter

Geological Survey

■ ***Informative - technical***

Bulletins, Reports, Records, Memoirs - are geoscientific publications describing the geology, mineral resources, and groundwater occurrences of particular parts of the State.
Microfilm/fiche of released company reports on mineral and petroleum exploration are available for inspection or purchase.

■ ***Geotechnical articles -***

Close range photogrametric mapping of open pit mine wall failures 1990
Geotechnical studies for open pit mines - Western Australian operating
Guidelines for the environmental management of mining in arid areas
Guidelines for preparation of a Notice of Intent - vat leach or extensions to existing structures
Guidelines for the preparation of a" Notice of Intent (NOI)" and Works Approval application for new tailings dams or extensions to existing dams
Guidelines on safety bund walls around abandoned pits - 1990
List of operating mines in WA
List of gold producers
Making the Grade (video and booklets)
Minesafe
Mining Engineering Division Fatal and lost time injuries - 1989/1990
Notes on pit wall stability
Occupational injuries in Western Australian mines - 1990 calendar year

■ ***Safety law pamphlets (Series 1):***

Accidents
Health and safety representative
Inspectors of mines and their powers
Record book
Resolutions of issues related to health safety and welfare

■ ***Safety law pamphlets (Series 2):***

Workmen's Inspectors of Mines
Classified machinery
Mine ventilation officers
Mine safety law
Noise.

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PUBLICATIONS

Seminar on open pit wall stability (produced in conjunction with the Chamber of Mines of Western Australia)
Significant incident reports - numbers 1 - 22
Stench gas emergency warning system - 1990
Ventilation Officers Course Notes (underground and surface) 1990
Safety Bulletins - numbers 1 - 5
Guidelines for the preparation of annual environmental reports 1991

■ ***Published Papers***

Cannon, M P: Land use and land care awareness: a programme information exchange and education between pastoralist, mining industry and the public (1990)
Fisher, T: Ventilation underground diesel engines: the regulations and the facts (1990)
Hartley, B M; Hewson, G S: Contribution of regulatory programs to radiation risk reduction in the mineral sands industry. In: Proceedings of Minesafe International 1990. Perth: Chamber of Mines & Energy: 1990
Hewson, G S; Hartley, G S: Radiation research priorities in the mineral sands industry. Journal of Radiological Protection 10: 221-229; 1990.
Hewson G S; Ralph, M I: Determination of effective protection factors for half-mask respirators used at a mineral sands separation plant. Submitted for publication 1990.
Knee, M: Role of the Department of Mines in occupational health and safety in the mining industry (1991).
Lindbeck, K E: 1991, Quarry and Open Pit Rehabilitation, Paper presented to 8th State Conference of the Local Government Engineers Association of WA, 5-8 March 1991.
Torlach, J M: Atmospheric contaminants; exposure limits and practical applications 1990
Torlach, J M; Johnston, B: Tyre fires and explosions: causes and prevention
Whiteley, M F: Accident analysis as a management tool for improved safety performance 1990.

Mining Registration

■ ***Informative***

Information Pamphlets
Basic Provisions
Guidelines on Reporting Requirements
Miner's Rights
Marking Out and Applying for Mining Tenements
Prospecting Exploration and Mining on Pastoral Leases
Mining Amendment Act No.22 of 1990
Exploration Licences - Graticular Boundary System
Prospecting Licences - A Guide to Holders

■ ***Promotional***

Computerised Mining Tenement Index System.

Petroleum

■ ***Informative***

Schedule of Onshore Petroleum Exploration and Production Requirements 1991.
List of Permittee/Licensee/Lessee Companies and titles.
Petroleum in Western Australia magazine.
Schedule of Specific Requirements as to Offshore Petroleum Exploration and production 1990.
Industry Safety memorandums.

Royalties and Policy Development

■ ***Informative***

Principal Gold Producers (produced twice a year for calendar and financial years).
Statistical Digest of Mineral Production (published twice a year to cover calendar and financial years).

Surveys And Mapping

■ ***Informative Maps***

Mineral Tenement Maps
Department Public Plans
Index to Public Plans
Mining Act - Section 57(4) Areas
Graticular Section Plans
Petroleum Tenement Maps
Brochure of Petroleum Tenements
Petroleum Tenement Map of the State
Petroleum Act Graticular Section Maps
Petroleum Tenement Maps

■ ***Thematic Maps***

Areas which have been held under Gold Mining Leases
Administrative Divisions
Historic Map - Wiluna to Kimberley Stock route
Index to Special Agreement Acts
Map Sheet Index
Mineral Production
Petroleum in Western Australia Tenement Map
Western Australian Localities Map with Gazetteer
Conservation Reserves of Western Australia, State Map
Conservation Reserves of Western Australia, South West Region
Aboriginal Reserves of Western Australia, State Map.

APPENDIX 4

PUBLIC RELATIONS

Royalties and Policy Development

The year saw the Communications Branch undertake a wide range of public relations and promotional activities.
These initiatives were all aimed at increasing public understanding and knowledge of the Department's role and operations, and also the important economic contribution made by the mining and petroleum industries in Western Australia.
Activities of the Branch during 1990-91 included:

Media Relations

Eighty-five media statements were prepared by the Branch and distributed to print and electronic media during the year.
These covered a wide subject range including the release of various industry statistics, amendments to the Mining Act, the release of new oil exploration areas, and comment upon major industry issues.
In addition, the branch responded to media requests for verbal comment on various issues and a sustained demand for very varied data by members of the general public. Again, these responses covered a wide subject range including health and safety, the environment, and policy issues.
Activities to increase the awareness of journalists included:

- A media tour of the Scuddles mine covering major mine safety and employee training initiatives;
- A familiarisation tour for journalists of the Department's Racing Chemistry Laboratory;
- A visit to the Perth office of Argyle Diamonds to be briefed on the work of the Government Diamond Valuer;
- The provision of historic photographs from the Department's archives to the Kalgoorlie Miner newspaper for use in a series of special articles on the early history of the Goldfields Region;
- The organisation and promotion of a special photographic competition featuring the State's mining and petroleum industries;
- The organisation of a special industry and media function for release of the Department's new guidelines for the safe abandonment of open pit minesites;
- A joint Police/Department of Mines media conference to release the findings of a blitz on vehicles transporting explosives and dangerous goods in the Perth metropolitan region;
- A media tour of the Kalgoorlie Explosives Reserve following publicity about site security;
- A media visit to the Kambalda nickel operations of Western Mining Corporation for a briefing on Department and company initiatives for minesite environmental rehabilitation; and a
- Media launch in Queen's Gardens, Perth, for the release of the Department's new guidelines for the rehabilitation of quarries.

Publications

The Department produced a range of technical and non-technical publications during the year.
A list of these technical publications appears in Appendix 3. Publications produced to reach a more general audience included:

- A new profile booklet on the Department, explaining its role, objectives, history and current functions;
- A regular internal newsletter for staff;
- A new magazine called Explosay targeting the safe handling, storage and transport of dangerous goods;
- The Department's 180 page Annual Review - a full report on important events and trends within the mining and petroleum industry and evolutions within the Department itself;
- The annual Statistical Digest - a summary of key industry production volume and value figures, together with other supportive data on current operators, etc;
- Various reports and guideline books including the guidelines for both the safe abandonment of open pit minesites and the rehabilitation of quarry sites; and
- A set of pamphlets promoting important aspects of minesite safety to workers in the industry.

Displays

The Department mounted a number of major public displays during the year, including:

- The WAMEX mining industry exposition, held annually at the Burswood Convention Centre, Perth;
- Minesite rehabilitation for the Library Association;
- The Minesafe exposition on mining safety held at the Burswood Convention Centre, Perth; and
- A display of the entries and winners in the Department's annual mining and petroleum industries photographic competition.

In addition, a number of displays were produced for a series of in-house expositions highlighting the role and function of specific divisions within the Department.

Geological Survey

- Participated in and presented papers at the International Conference on Groundwater in Large Sedimentary Basins, and ran successful field excursions for the 3rd International Archaen Symposium held in Perth;

APPENDIX 4

PUBLIC RELATIONS

- Prepared a display for the joint Geological Society of Australia/Society of Exploration Geophysicists Conference in Sydney;
- In conjunction with the Petroleum Division organised a Western Australian Basins seminar at which a number of papers on the geology and petroleum potential of several sedimentary basins were presented by Department, BMR, and industry speakers. The Geological Survey also ran field excursions in the Bonaparte and Carnarvon basins for industry personnel; and
- Gave a seminar on open-pit stability at five centres in the Eastern Goldfields, Yilgarn and Murchison.

The Chemistry Centre

- Organised and presented papers at the International Association of Forensic Toxicologists Conference held in Perth;
- Prepared a display for WAMEX featuring the mineral-related laboratories;
- Produced a range of brochures relating to general and specific aspects of the Chemistry Centre's laboratories;
- Arranged tours of the Chemistry Centre for various groups;
- Presented talks on many diverse topics throughout the year. These included: gold recovery, cyanide in the environment, treatment of swimming pools, pesticide analysis, heavy metal environmental problems, fire assaying, atomic absorption spectroscopy, liquid chromatography and atmospheric chemistry;
- Hosted a number of overseas and interstate visitors;
- Organised for two Research Fellows from Curtin University of Technology Pharmacy Department to spend their study leave in the Chemistry Centre, one in Agricultural Chemistry Laboratory and one in Forensic Science Laboratory;
- Helped work experience students, as well as University students, as part of their studies, participate in the activities of several Chemistry Centre laboratories; and
- Gave a series of lectures to third year chemistry students at the University of Western Australia. This involved a range of staff from several laboratories lecturing on various topics in applied analytical chemistry.

Petroleum

- Mounted a comprehensive display featuring the Division's role in the WA petroleum industry for the Petroleum Technology Australia 1990 Oil and Gas Expo at Burswood Superdome.

Explosives and Dangerous Goods

Launched a quarterly newsletter titled Explosay specifically directed at the dangerous goods industry. Through the newsletter current information relating to explosives and dangerous goods, changing regulations and policy, accident details and details of the Division's operation is circulated to a broad industry base.

Mining Registration

Held a Divisional exposition to increase awareness of its activities and expertise within the Department; and Arranged a Mining Registrars' conference and seminars for staff, industry and the public to explain major legislative amendments, including the implementation of a graticular boundary system for exploration licences.

APPENDIX 5

BOARDS AND COMMITTEES

The Department of Mines has representation on the following committees which are either inter-departmental or include representatives from non-government organisations. Internal committees are not included.

Statutory

Board of Examiners for Mine Managers and Underground Supervisors (Metalliferous)

Boards of Examiners, Mine Managers and Deputies (Coal)

Board of Examiners for Quarry Managers

Coal Mines Accident Relief Fund Committee

Coal Mines Accident Relief Fund Trust

Coal Miners Welfare Board

Mine Workers Relief Fund Board

Radiation Safety Board

Selection Committee for Inspectors of Mines

Mines Survey Board

Ventilation Board

Chemistry Centre (WA)

Academic Board - WA School of Mines

Advisory Committee - WA School of Mines

Advisory Committee for the Purity of Water

Agricultural Chemistry Laboratory Alterations Project Control Group

Amira Cyanide Project

Australasian Institute of Mining and Metallurgy Kalgoorlie Branch

Australian Society of Soil Science (WA) Branch Committee

Australian X-Ray Analytical Committee

Bayswater Integrated Catchment Management Technical Advisory Committee

BrodieHall Mining Research and Consultancy Centre, WASM

Chemistry Centre CSA Works Committee

Chemistry Centre Geological Survey Liaison Committee

Drug Advisory Committee

Fluoridation of Public Water Supplies Advisory Committee

Government Paint Committee State Technical Working Group

Grain Pool Legume Advisory Committee

Harding Dam Water Quality Committee

Hazardous Substances Advisory Committee

Hazardous Substances Advisory Committee

Working Party Termiticides

Institute of Engineers (Australia) Kalgoorlie

International Lupin Executive

Kwinana Groundwater Pollution Control Technical Committee

Licence Advisory Panel of Rights in Water and Irrigation Act

Mines Department Hazardous Substances Committee

NATA Chemical Testing Registration Advisory Committee

Pesticides Advisory Committee

Poisons Advisory Committee

SAA CH/10/4 Mineral Standards Board Precious Metals Sub-committee

SAA MN/ Mineral Standards Board

SAA MN/1/1/7 Coal and Coke,Trace Elements

SAA MN/2/2 Chemical Analysis of Iron Ores

SAA MN/2/2/1 X-Ray Fluorescence

SAA MN/3/2 Analysis of Aluminium Ores

SAA MN/4/2 Chemical Analysis of Heavy Mineral Sands Subcommittee

SAA MN/5/1 - Chemical Analysis of Copper, Lead, Zinc, Gold and Silver Ores and Concentrates

State Tender Board Cleaning Polishing and Maintenance Products

State Tender Board Cleaning Products Detergents

State Tender Board Paint Advisory Committee

Swan River Trust Environmental Quality Committee

Toxichem Chemical Information Project Professional Advisory Group

Veterinary Preparation and Animal Feed Advisory Committee

WA Food Advisory Committee

WAACHS Sub-committee on Asbestos Cement Products

WAACHS Subcommittee on Organochlorine Use as Termiticides

WARD Grants Assessment Panel (WA Research and Development)

Corporate Development

Common Use Purchasing System (CUPS)

Government Accounting System Management Committee

Hedland College Council

Hedland College Finance and Staff Committee

Human Resource Planning Committee

Mines/BMA Monthly Review Committee

National RMS Users Group

APPENDIX 5

BOARDS AND COMMITTEES

RMS Management Committee for W.A.Government

RMS Users' Working Group

Records Management Liaison Committee

Staff Development Officers Network Coordinating Committee

Supplynet User Group Government

WA Government Task Force on Information Technology Establishments

Executive Division

Australasian Institute of Mining and Metallurgy

Australian Ionising Radiation Advisory Council

Australian Minerals and Energy Council Ecologically Sustainable Development Working Group on Mining

Australian Minerals and Energy Council (AMEC)

Standing Committee of Officials

Chemistry Centre Advisory Council

Chemistry Centre Steering Group

Country Planning Council

Gold Producers' Association Ltd

Information Technology Advisory Committee

Mining Industry Liaison Committee

Standing Committee to Ministerial Council on Mining and Conservation

WA Advisory Committee on Hazardous Substances

WA Mining Education Consultative Committee

WA Water Resources Council

WA Water Resources Council Conservation Committee

Explosives and Dangerous Goods

Association of Australian Port and Marine Authorities Dangerous Goods Committee

Hazardous Industries Technical Group

Kemerton Industrial Working Committee

Kemerton Park Advisory Board

Kwinana Industrial Coordinating Committee Improvement Plan 14 Working Group

Kwinana Integrated Emergency Management System Executive Coordinating Committee

Kwinana Integrated Emergency Management System Emergency Services Subcommittee

Kwinana Integrated Emergency Management System Technical Advisory Subcommittee

National Task Force on Hazardous Industry and Landuse Safety Planning

Public Safety Sub-committee

SAA CH/9 Safe Handling of Chemicals

SAA ME/15 Liquefiable Petroleum Gases

SAA ME/17 Flammable and Combustible Liquids

SAA ME/50 Road/Rail Tankers Fluid Transfer Components

SAA ME/57 Road Tankers for Hazardous Liquids and Gases

SAA ME/70 Liquefied Natural Gas Storage and Handling

State Government Counter Disaster Advisory Committee

Transport of Dangerous Goods Competent Authorities Subcommittee

Transport of Dangerous Goods Drafting Subcommittee

Transport of Dangerous Goods Explosives Working Group

Transport of Dangerous Goods Advisory Committee

WA Hazardous Materials Emergency Management Scheme Preparedness and Response Subcommittee

Working Party for Transport Routes (WAACHS)

Geological Survey

Australian Earth Science Information System (AESIS) Advisory Committee

Australian Mineral Foundation (AMF) Council

Australian Resources Industry Database (ARID) Advisory Council

Bauxite Sub-committee

Bunbury/Wellington Regional Planning Committee

Chamber of Mines and Energy Liaison Group

Coastal Groundwater Scheme Steering Group

Coastal Management Coordinating Committee

Cockburn Cement Dredging and Management Program Working Group

Cockburn Groundwater Pollution Control Advisory Committee

CSIRO Mindarie Waste Disposal Site Committee

EPA Red Book Task Force

Extractive Industry Committee

Geological Survey Liaison Committee

Geology Advisory Committee

Gnangara Mound Technical Advisory Group

Government Geologists' Conference

Government Geosciences Database Policy Advisory Committee

GSWA State Water Resources Information Steering Committee

GSWA/WAWA Groundwater Liaison Committee

Harding Dam Water Quality Committee

APPENDIX 5

BOARDS AND COMMITTEES

Hydrogeology Subcommittee (of the Geological Survey Liaison Committee)

Integrated Catchment Management Policy Group

Kingstown Advisory Committee

Land Salinisation Sub-committee of RSC

RSC Landuse and Groundwater Interactions on the Coastal Plain Sub-committee

RSC Water Resource Catchment Rehabilitation

Research on Land Use and Water Supply Steering Committee

Rockmin Review Committee

Rockmin Steering Committee

Rottnest Island Authority Environmental Advisory Committee

Rottnest Island Research Committee

State Tender Board Procurement of Motor Vehicles Advisory Sub-committee

Technical Committee for Estimating Recharge for Sub-regions with Multiple Landuse

WA Water Resources Council Groundwater Management Committee

WAWA/SWRIS Review Committee

WAWA/SWRIS Steering Committee

Yilgarn Craton Liaison Subcommittee of the Geological Survey Liaison Committee

Mining Engineering

Board of Examiners (Coal Mines Regulation Act)

Board of Examiners (Mine Managers and Underground Supervisors) Mines Regulation Act

Board of Examiners (Quarry Managers)

Coal Education Committee of Collie TAFE

Coal Miners Welfare Board

Coal Mines Accident Relief Fund Trust

Collie Federated School of Mines Advisory Council

Mines Radiation Safety Board

Mines Rescue Competition Committee

Mines Rescue Trainee Assessment Committee

Mines Survey Board

Mines Ventilation Board

Mining Operations Group

WA Coal Industry Council

WA Coal Industry Council Standing Committee

WACIC - Occupational Health and Safety Control Committee

Petroleum

Committee for Local Industry Participation

Consultative Committee on Safety in the Offshore Petroleum Industry in Australia

Government Regulating Authorities Pipelines Advisory Group

Montebello Island Marine Park Proposal Ad Hoc Committee

North West Shelf Security Working Group

Offshore Engineering Program Advisory Panel

Onshore Petroleum Legislation Sub-committee

Petroleum Conservation Consultative Committee

Petroleum/Fishing Industries Appeal Meetings

Petroleum Industry Liaison Committee

Standing Committee on Offshore Petroleum Legislation

State Committee for Combating Marine Oil Pollution

Mining Registration

Australian Minerals and Energy Council

Working Group on Mineral Royalties

Royalties and Policy Development

Minedex Steering Committee

Surveys and Mapping

Australian Institute of Cartographers (WA Division)

CSA Cartographic Sub-association

Computer-aided Map Publishing Committee

Geodetic Survey and Computing Technical Sub-committee

Geographic Names Committee

Multiskilling and Job Design Consultative Committee

WA State Emergency Service Liaison Officers

WA Survey and Mapping Advisory Committee

WALIS Council

WALIS Digital Capture of Cadastral Information Sub-committee

WALIS Technical Sub-committee

APPENDIX 6

DEPARTMENTAL DIRECTORY

HEAD OFFICE

Department of Mines
Mineral House Complex
100 Plain Street (cnr Adelaide Terrace)
EAST PERTH Western Australia 6004
Telephone (09) 222 3333
Fax (09) 222 3430
Telex AA95791 MINEWA

Office of Director General of Mines
8th Floor Mineral House South
100 Plain Street (cnr Adelaide Terrace)
EAST PERTH Western Australia 6004
Telephone (09) 222 3333
Fax (09) 222 3510
Telex AA95791 MINEWA

DIVISIONS

- **Chemistry Centre WA**

Chemistry Centre WA
125 Hay Street
EAST PERTH Western Australia 6004
Telephone (09) 325 5544
Fax (09) 325 7767
Telex AA95791 MINEWA

Mineral Processing Laboratory
19 Catherine Street
BENTLEY Western Australia 6102
Telephone (09) 458 9088
Fax (09) 351 8197
Telex AA95791 MINEWA

Regional Office

Kalgoorlie Metallurgical Laboratory
95 Egan Street (Box 881)
KALGOORLIE Western Australia 6430
Telephone (090) 220 120
Fax (090) 912 762

- **Corporate Development**

Corporate Development Division
7th Floor Mineral House South
100 Plain Street (cnr Adelaide Terrace)
EAST PERTH Western Australia 6004
Telephone (09) 222 3333
Fax (09) 222 3430
Telex AA95791 MINEWA

- **Explosives and Dangerous Goods**

Explosives and Dangerous Goods Division
9th Floor Mineral House North
100 Plain Street (cnr Adelaide Terrace)
EAST PERTH Western Australia 6004
Telephone (09) 222 3333
Fax (09) 222 3525
Telex AA95791 MINEWA

Baldivis Explosives Reserve
Stakehill Road
BALDIVIS Western Australia 6171
Telephone (09) 524 1301
Fax (09) 524 1792

Regional Office

Kalgoorlie Explosives Reserve
Piccadilly Street West
KALGOORLIE Western Australia 6430
Telephone (090) 218 246
Fax (090) 913 222

- **Geological Survey of WA**

Geological Survey of Western Australia
5th Floor Mineral House South
100 Plain Street (cnr Adelaide Terrace)
EAST PERTH Western Australia 6004
Telephone (09) 222 3333
Fax (09) 222 3633
Telex AA95791 MINEWA

Geological Survey Transport and Equipment Store
37 Harris Street
CARLISLE Western Australia 6101
Telephone (09) 470 0308

Geological Survey Core Library
15 Harold Street
DIANELLA Western Australia 6062
Telephone (09) 222 3277

Geological Survey Laboratories
37 Harris Street
CARLISLE Western Australia 6101
Telephone (09) 470 0324

Regional Office

Kalgoorlie Regional Office

WA School of Mines
Egan Street
KALGOORLIE Western Australia 6430
Telephone (090) 213 066
Fax (090) 912 428

- **Mining Engineering**

Mining Engineering Division
6th Floor Mineral House North
100 Plain Street (cnr Adelaide Terrace)
EAST PERTH Western Australia 6004
Telephone (09) 222 3333
Fax (09) 325 2280
Telex AA95791 MINEWA

Exploration Safety and Drilling
91 Briggs Street
WELSHPOOL Western Australia 6106
Telephone (09) 470 0300
Fax (09) 362 5694

Regional Offices

Collie

Coal Industries Council
Unit 1 Forrest Forum
Forrest Street
COLLIE Western Australia 6225
Telephone (097) 344 599
Fax (097) 344 142

Regional Mining Engineer
66 Wittenoom Street
Collie Western Australia 6225
Telephone (097) 341 222
Fax (097) 341 606

APPENDIX 6

DEPARTMENTAL DIRECTORY

Kalgoorlie
Regional Mining Engineer
Brookman Street (Box 671)
KALGOORLIE Western Australia 6430
Telephone (090) 213 066
Fax (090) 213 612

Karratha
Regional Mining Engineer
Hedland Place (Box 518)
KARRATHA Western Australia 6714
Telephone (091) 868 243
Fax (091) 868 241

■ **Mining Registration**
Mining Registration Division
1st Floor Mineral House North
100 Plain Street (cnr Adelaide Terrace)
EAST PERTH Western Australia 6004
Telephone (09) 222 3333
Fax (09) 222 3452
(09) 222 3444
Telex AA95791 MINEWA

Regional Offices

Broome
Mining Registrar
Court House (Box 28)
BROOME Western Australia 6725
Telephone (091) 921 137
Fax (091) 921 878

Carnarvon
Mining Registrar
Court House (Box 35)
CARNARVON Western Australia 6701
Telephone (099) 411 082
Fax (099) 412 779

Coolgardie
Mining Registrar
40 Bayley Street (Box 41)
COOLGARDIE Western Australia 6429
Telephone (090) 266 066
Fax (090) 266 204

Kalgoorlie
Mining Registrar
Brookman Street (Box 364)
KALGOORLIE Western Australia 6430
Telephone (090) 213 066
Fax (090) 912 428

Kununurra
Mining Registrar
Court House (Box 917)
KUNUNURRA Western Australia 6743
Telephone (091) 681 011
Fax (091) 681 103

Leonora
Mining Registrar
Rochester Street (Box 4)
LEONORA Western Australia 6438
Telephone (090) 376 106
Fax (090) 376 248

Marble Bar
Mining Registrar
Bohemia Road (Box 7)
MARBLE BAR Western Australia 6760
Telephone (091) 761 044
Fax (091) 761 048

Meekatharra
Mining Registrar
Main Street (Box 7)
MEEKATHARRA Western Australia 6642
Telephone (099) 811 008
Fax (099) 811 482

Mt Magnet
Mining Registrar
Richardson Street (Box 13)
MT MAGNET Western Australia 6638
Telephone (099) 634 040
Fax (099) 634 488

Norseman
Mining Registrar
Princep Street
NORSEMAN Western Australia 6443
Telephone (090) 391 082
Fax (090) 391 657

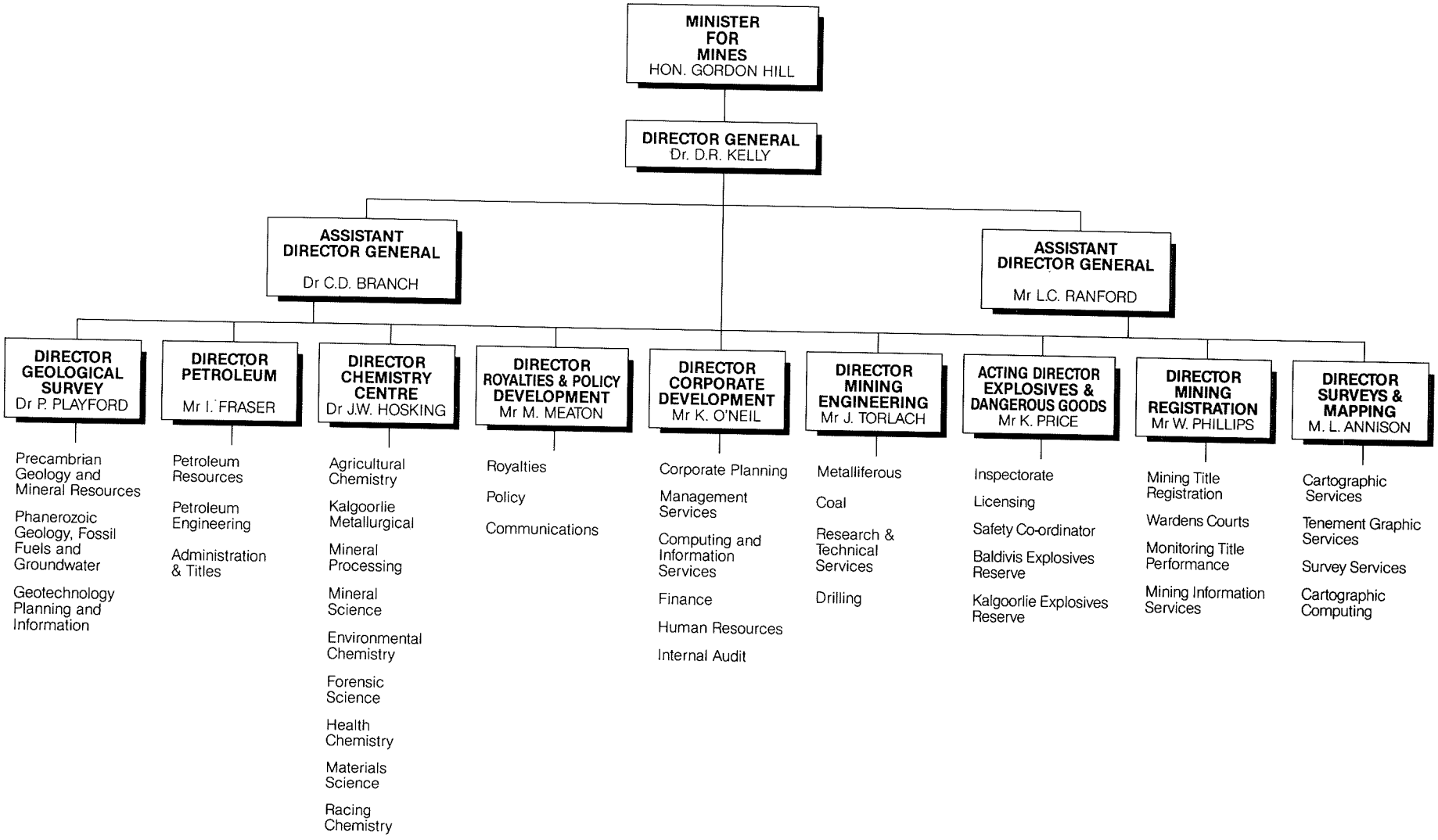
Southern Cross
Mining Registrar
Great Eastern Highway
SOUTHERN CROSS Western Australia 6426
Telephone (090) 491 107
Fax (090) 491 431

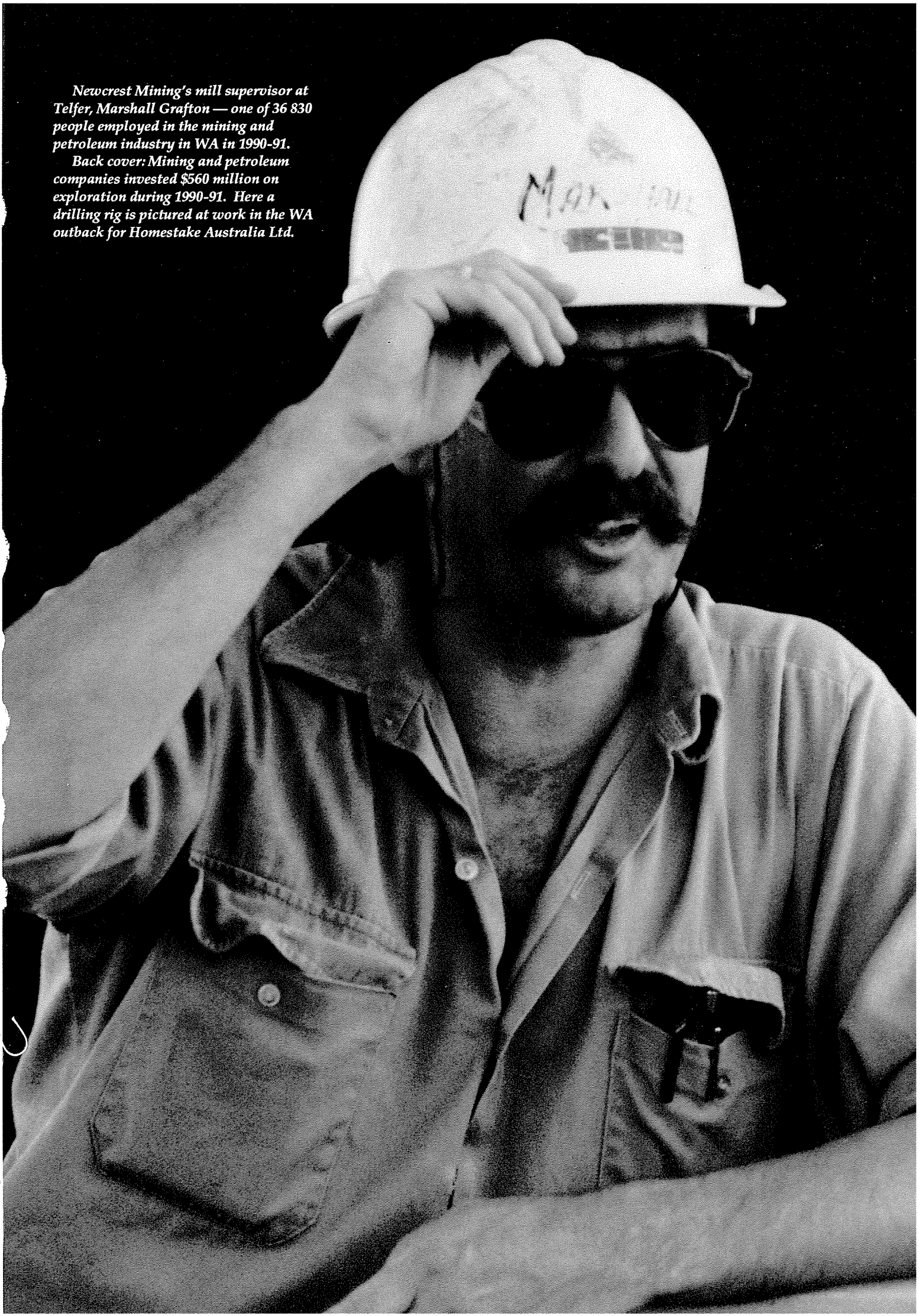
■ **Petroleum**
Petroleum Division
3rd Floor Mineral House South
100 Plain Street (cnr Adelaide Terrace)
EAST PERTH Western Australia 6004
Telephone (09) 222 3333
Fax (09) 222 3515
Telex AA95791 MINEWA

■ **Royalties and Policy Development**
Royalties and Policy Development Division
10th Floor Mineral House North
100 Plain Street (cnr Adelaide Terrace)
EAST PERTH Western Australia 6004
Telephone (09) 222 3333
Fax (09) 222 3289
(09) 222 3069
Telex AA95791 MINEWA

■ **Surveys and Mapping**
Surveys and Mapping Division
2nd Floor Mineral House North
100 Plain Street (cnr Adelaide Terrace)
EAST PERTH Western Australia 6004
Telephone (09) 222 3333
Fax (09) 222 3342
Telex AA95791 MINEWA

ORGANISATION CHART





Newcrest Mining's mill supervisor at Telfer, Marshall Grafton — one of 36 830 people employed in the mining and petroleum industry in WA in 1990-91.

Back cover: Mining and petroleum companies invested $560 million on exploration during 1990-91. Here a drilling rig is pictured at work in the WA outback for Homestake Australia Ltd.