

# Kwinana Industrial Area Economic Impact Study

*an example of industry interaction*

April 2002



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## SINCLAIR KNIGHT MERZ

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The photographs on the cover page have been provided courtesy of Western Power, the Department of Mineral and Petroleum Resources, the Department of Planning and Infrastructure and the Chamber of Commerce and Industry of Western Australia.

## Abstract

This is a report on the Kwinana Industrial Area (KIA), commissioned by the Kwinana Industries Council (KIC) and the Chamber of Commerce and Industry of WA (CCI) [in association with others] and prepared by Sinclair Knight Merz.

This report looks at financial, social, material and energy data and provides a realistic and conservative view of Kwinana industries. It is based on the responses from 28 (out of 35) surveys, data and opinion from support industries, and state and local government agencies.

The following key findings confirm that the KIA is the State's premier industrial area.

### **The Kwinana Industrial Area: -**

1. **Is a major source of revenue for the State and Australian economies** (with direct sales of \$4.34B per annum where \$1.58B relates to export markets, and a further \$326M of "exports" to other Australian States).
2. **Is the State's largest industrial area** and accounts for 22 per cent of the WA manufacturing sector's total factor income (sum of wages, salaries and gross margin before tax or depreciation) of \$1,275M.
3. **Has annual output worth \$8.7B** (with employee earnings of \$600M and 24,400 direct/indirect jobs) which represents the output, employee earnings and jobs that could be lost if industries disappeared and were not replaced.
4. **Employs 3,636 people directly** (70 per cent live locally) and pays \$207M in annual salaries and wages.
5. **Contributes a high degree of social benefit to employees and the community**, with a high level of employee services and at least half of community activities funding spent locally. Several companies consult actively and continually to gain better understanding of local communities' key issues and priorities.
6. **Has grown significantly since its inception in 1952** and represents a unique blend of connecting heavy, support and infrastructure industries. The study identifies 106 customer/supplier relationships between pairs of industries and a further 104 possible interactions (compared with a 1990 study which surveyed 13 industries and identified only 27 existing interactions).
7. **Plans for capital expenditures** of \$812M over the next five years, and an additional \$1,212M for the subsequent five years.

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## Executive Summary

This is a report on the Kwinana Industrial Area (KIA), commissioned by the Kwinana Industries Council (KIC) and the Chamber of Commerce and Industry of WA (CCI) [in association with the Department of Mineral and Petroleum Resources, the Department for Planning and Infrastructure and LandCorp] and prepared by Sinclair Knight Merz. Environment Australia also partly funded this study.

This report looks at financial, social, material and energy information and:

- measures the direct (and indirect) economic and social importance of Kwinana industries to local, West Australian and Australian communities;
- measures the benefit of additional industrial and port development (subject to new planning initiatives and land availability) and identifies these options;
- recognises positive community impacts (such as training and educational schemes); and
- ascertains opportunities for sustainable industrial development (through a review of industry interaction) and identifies new resource saving, and reuse and recycling opportunities.

This report is based on the responses from 28 (out of 35) Kwinana industries surveyed and data and opinion from Kwinana industries, support industries, government planning bodies and other interested parties.

**The major findings of the study** show Kwinana industries:

- have a major positive impact on the WA economy through their large operational and capital expenditures;
- link to the energy, minerals and agricultural industries of the State, as suppliers of essential inputs and as value-adding processors of primary outputs;
- make a major positive contribution to Australia's international balance of payments through exports and import replacement;
- create a much larger amount of employment than their direct employment through multiplier effects;
- produce a much larger amount of income than the wages and salaries of their employees through multiplier effects, dividends and payment of taxes;
- generate significant benefits to the local community by providing employment, employee training and sponsorship of community activities; and
- demonstrate an increasing level of environmental performance and initiative which benefits the local community.

### 1. Economic Benefits

Kwinana industries are a major driver for the WA economy. The 'bottom line' is that annual output worth \$8,700M, employee earnings of \$600M and 24,400 jobs are directly or indirectly dependent on Kwinana operations and investment.

These industries account for a total factor income (sum of wages, salaries and gross margin before tax or depreciation) of \$1,275M which equates to two percent of the \$62,412M of this income for WA<sup>1</sup>.

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<sup>1</sup> Australian Bureau of Statistics (2000) *Australian National Accounts - State Accounts* Cat No. 5220.0  
Australian Bureau of Statistics, Canberra.

When considering the manufacturing sector only, Kwinana industries account for 22.2 percent of this income for that sector, and Kwinana remains the most important heavy industry area within WA and the Perth metropolitan area.

*The key economic impacts of the Kwinana industries are summarised in Table ES.1 and Table ES.2.*

§ **Table ES.1 Summary of Existing and Potential Economic Benefits**

	Output (\$M)	Wages & Salaries (\$M)	Employment (jobs)
Direct Impacts of Existing Industries at 1999-00 Output Levels (Kwinana On-site)	4,342 <sup>1</sup>	207	3,636
Total Impact of Existing Industries after Multiplier and Capital Expenditure Effects	8,714 <sup>2</sup>	599	24,397
Total Impact of Existing Industries and Potential Activity for 2009-10	14,992	1,338	39,048

Note:

<sup>1</sup> includes international exports of \$1,581M and "exports" to Australia of \$326M.

<sup>2</sup> equates to 5 per cent of calculated \$163B total output for WA.

§ **Table ES.2 Summary of Factor Income and Planned Capital Expenditure**

	\$M
Total Factor Income (the sum of wages, salaries and gross margin before tax or depreciation)	1,275
Planned Capital Expenditure of Existing Industry	
2000-05	812
2006-10	1,212

## 2. Industrial Development and Integration

Due to a range of factors the Kwinana Industrial Area has grown significantly since the original economic impact study of 1990 (Dames & Moore, 1990b) and displays a unique blend of interdependent heavy, support and infrastructure industries. (*Figure 1.1 illustrates development over time*).

There are several proposals in the public domain for new industries such as Rio Tinto Limited's HIsmelt plant, Global Olivine Western Australia's Waste to Energy and Water Plant, and the James Point port. The survey identified numerous potential industry opportunities that may add significantly to the number of interactions between Kwinana industries.

*The key industrial development and integration impacts of the Kwinana industries are summarised in Table ES.3 and Table ES.4.*

§ **Table ES.3 Comparison of Results with 1990 Kwinana Heavy Industry Study**

	1990 Study (88-89 Prices)	1990 Study (99-00 Prices)	Present Study (99-00 Prices)	Present Study (% of 1990 Study)
<b>Annual Industry Output (\$M):</b>				
Total Output: Basic Metal; Chemical and Petroleum; and Non-metallic Mineral products.	2,371	2,855	4,037	141%
Other categories of industry not included in the 1988-89 survey.			305	
Total Output 1999-00.			4,342	
<b>Wages and Salaries (\$M):</b>				
Total Wages and Salaries: Basic Metal; Chemical and Petroleum; and Non-metallic Mineral products.	179	224	187	83%
Other categories of industry not included in the 1988-89 survey.			20	
Total Wages and Salaries 1999-00.			207	
<b>Employment (Jobs):</b>				
Total Employment: Basic Metal; Chemical & Petroleum; and Non-metallic Mineral products.	3,124		3,019	97%
Other categories of industry not included in the 1988-89 survey.			617	
Total Employment 1999-00.			3,636	

Notes:

This table provides a comparison with the 1990 *Kwinana Heavy Industry Economic Impact Study* (Dames & Moore, 1990b) based on 1988-99 data.

The present study is broader in scope than the 1990 study with more categories. It shows Total Output has increased significantly (141 per cent for comparable sectors) and Wages and Salaries and Employment have declined slightly (demonstrating greater productivity of Kwinana industries in the present study).

§ **Table ES.4 Summary of Kwinana Industries and Interactions**

	1990 Study	Present Study
Existing Core Process Industries	13	21
Existing Service and Infrastructure Industries	Not Studied	7
<b>Total Industries Studied</b>	<b>13</b>	<b>28</b>
Existing Interactions between Core Process Industries	27	68
Additional Existing Interactions Considering Service and Infrastructure Industries	Not Studied	38
<b>Total Existing Interactions</b>		<b>106</b>
Potential Interactions between Existing Core Process Industries	2	55
Additional Potential Interactions Considering Existing Service and Infrastructure Industries	Not Studied	49
<b>Total Potential Interactions</b>		<b>104</b>

Note:

This table illustrates the growing interdependency of Kwinana industries and represents either transfer of product(s) or commercial co-operation. There may be several different products traded for each interaction.

The present study is more extensive than the 1990 study, which may account for some of the growth in interactions.

### **3. Environmental Performance**

Surveyed Kwinana industries described their environmental initiatives using these categories:

- cleaner production;
- waste minimisation;
- energy efficiency;
- water conservation; and
- noise abatement.

Responses highlight a high standard of improvement in environmental performance. The industries demonstrate a strong understanding of these environmental trends and most have programs operating to address these and other environmental issues.

Several demonstrate a significant commitment to their environmental performance by winning awards from external bodies and government for their positive approach to environmental issues. Several have ISO 14001 accreditation and others are working towards this international standard.

The interdependency of Kwinana industries helps provide environmental benefits beyond what is achieved by widely dispersed industries. Their physical proximity and interaction allows trading of by-products for reuse and co-operative energy efficiency ventures, which would be uneconomical if there were significant distances between facilities.

### **4. Social Benefits**

These flow to the local and wider community from existing industrial businesses in the study area. For the purpose of this report the local community is defined as the local government areas of Cockburn, Rockingham and Kwinana [CRKLA].

Kwinana industries provide the following:

#### **i) Direct and indirect employment**

There is a high degree of direct employment (3,490 full-time jobs and 146 part-time jobs); 70 per cent of employees live in the CRKLA area; and significant indirect and induced employment (24,400 jobs).

#### **ii) Services and social initiatives**

There is a high level of employee support with a range of services, flexible work options and innovative employment benefits provided including:

- |                                |                              |
|--------------------------------|------------------------------|
| □ flexible working hours       | □ medical                    |
| □ sick and bereavement leave   | □ physiotherapy              |
| □ adoption leave               | □ dietetics                  |
| □ ceremonial leave             | □ free vaccinations          |
| □ paternity leave              | □ fitness training           |
| □ childcare support facilities | □ first aid training         |
| □ career planning              | □ weight loss programs       |
| □ financial planning           | □ provision of low fat meals |
| □ personal counselling         |                              |

**iii) Support for significant local community issues**

There is proactive support, including a high contribution of funding, for local and wider community activities (with at least half of funding spent locally). These activities fall in the following categories:

- ☐ environmental;
- ☐ education and training;
- ☐ sports and recreation;
- ☐ family and children;
- ☐ community services;
- ☐ community events; and
- ☐ general community sponsorships.

Several companies provide active and continuous community consultation processes, contribute to the local community and seek to understand key local community issues and priorities.

**Conclusions**

The study shows Kwinana industries contribute a wide range of economic, environmental and social benefits to the local community, Western Australia and Australia.

The continued operation of the Kwinana industries (and heavy industry in general) depends on its ability to remain competitive in a world where barriers to trade and competition are progressively being dismantled. Whether a heavy-industry plant is wholly owned within Australia or is part of a multi-national company, its competitive standing is continually being tested. This occurs through the market, and through corporate assessments of where it is most profitable to locate plants.

To remain competitive, a plant must maintain its “comparative advantage”. This depends on a wide range of factors, many of which are beyond the control of governments or the industry managers themselves.

*The key factors to remaining competitive are summarised in **Table ES.5** and **Table ES.6**.*

§ **Table ES.5 Factors to Maintain Industries’ Comparative Advantage (Managers)**

<b>Factors that can be influenced by Facility Managers</b>
Maximising operational efficiency and productivity through continuous improvement: plant optimisation, elimination of bottlenecks, minimisation of input costs, and adoption of enlightened workforce training and safety procedures.
Exploiting opportunities for developing new products, production technologies and developing new markets.

§ **Table ES.6 Factors to Maintain Industries’ Comparative Advantage (Government)**

<b>Factors that can be influenced by Government</b>
Maintenance of political stability.
Macro-economic management and tax regimes.
Minimising compliance costs of environmental protection.
Providing adequate environmental and safety buffers for industry.
Developing workable industrial relations policies and practices.
Supporting development of complementary industry and infrastructure throughout the State to provide new processing opportunities, and cost-effective inputs and distribution systems.
Ensuring appropriately sized land parcels remain available for industry growth.

Key stakeholder groups participated in the design and implementation of this study and reflected a strong understanding of the wider community benefits provided by their industries. This co-operation also demonstrates the willingness to work together to secure the future for Kwinana industries and the community.

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# Contents

<b>Abstract</b> .....	
<b>Executive Summary</b> .....	<b>i</b>
<b>1. Introduction</b> .....	<b>1</b>
<b>2. Existing Kwinana Industrial Area</b> .....	<b>5</b>
2.1 Introduction.....	5
2.2 Core Process Industries .....	7
2.3 Infrastructure and Utilities .....	7
2.4 Support Industries .....	7
<b>3. Potential Industrial Development</b> .....	<b>9</b>
3.1 Introduction.....	9
3.2 Development Prospects.....	9
3.2.1 Existing Synergies Between Industries .....	9
3.2.2 Opportunities for Synergies Between Existing Industries .....	10
3.3 Opportunities for New Industries.....	12
3.3.1 Projects Seeking Approvals .....	12
3.3.2 Projects in Feasibility Stages .....	12
3.3.3 Opportunities Identified through the Study .....	13
3.4 Opportunities and Constraints to Future Development .....	14
3.4.1 Regional Planning Opportunities and Constraints .....	14
3.4.2 Infrastructure and Services Opportunities and Constraints .....	16
3.4.3 Land Availability for Industries.....	17
3.4.4 Environmental and Social Opportunities and Constraints.....	18
<b>4. Economic Benefits of Heavy Industry at Kwinana</b> .....	<b>21</b>
4.1 Introduction.....	21
4.1.1 Economic Perspective .....	21
4.1.2 Methodology .....	22
4.2 Kwinana’s Direct Economic Impact.....	23
4.2.1 Kwinana as a Supplier of Goods and Services .....	23
4.2.2 Incomes generated at Kwinana.....	23
4.2.3 Employment.....	24
4.2.4 Capital Investment.....	25
4.3 Kwinana’s Total Economic Impact .....	27
4.3.1 Impact Assessment Method .....	27
4.3.2 Results for Income, Earnings and Employment .....	27
4.3.3 Results for Capital Investment .....	29
4.3.4 Summary of the Economic Impacts of Existing Kwinana Industries.....	30
4.4 Comparison with the 1990 Economic Impact of Heavy Industries in Kwinana.....	30
4.5 Impacts on the National Economy .....	32
4.5.1 Output and Household Income.....	32
4.5.2 International Balance of Payments.....	32
4.6 Future Prospects for Existing Kwinana Industries .....	33
4.6.1 Positives and Negatives for Kwinana’s Comparative Advantage .	33
4.6.2 Key Factors Influencing Future Plans .....	34
4.6.3 Expected Impact from Growth of Existing Kwinana Industries .....	37
4.7 Potential Economic Impacts of New Industrial Development in the Kwinana Industrial Area.....	40

4.7.1	Projects with Known Proponents.....	40
4.7.2	Potential Economic Impact of Technical Development Options for Industrial Development of the Kwinana Region.....	42
4.8	Summary of Economic Impacts .....	43
<b>5.</b>	<b>Environmental Performance.....</b>	<b>45</b>
5.1	Cleaner Production .....	45
5.2	Waste Minimisation .....	46
5.3	Energy Efficiency.....	46
5.4	Water Conservation .....	47
5.5	Noise Abatement.....	48
5.6	Sulphur Dioxide Emissions Management .....	48
5.7	Environmental Initiatives Coordinated and/or Contributed to by KIC .....	51
<b>6.</b>	<b>Social Benefits of Heavy Industry at Kwinana.....</b>	<b>53</b>
6.1	Introduction and Background.....	53
6.1.1	Approach to Social Benefit Study.....	53
6.1.2	Key Criteria for Determining Social Benefits .....	53
6.2	Existing Social Environment .....	53
6.2.1	Regional Overview .....	53
6.2.2	CRKLA.....	55
6.2.3	Kwinana.....	55
6.2.4	Cockburn .....	56
6.2.5	Rockingham.....	57
6.2.6	Summary .....	58
6.3	Survey Responses .....	59
6.3.1	Employment.....	59
6.3.2	Travel to Work .....	67
6.3.3	Community and Employee Performance .....	68
6.4	Initiatives of the Kwinana Industries Council (KIC).....	74
6.5	Analysis and Discussion .....	75
6.5.1	Direct and Indirect Employment Provided by the Industries to the CRKLA and Wider Community.....	75
6.5.2	Services and Social Initiatives Provided to the Industry Workforce .....	76
6.5.3	Industry Attempts to Understand and Positively Respond to Significant Local Community Issues. ....	76
6.6	Summary and Conclusions.....	78
<b>7.</b>	<b>Conclusions.....</b>	<b>81</b>
<b>8.</b>	<b>References .....</b>	<b>83</b>
<b>9.</b>	<b>Abbreviations .....</b>	<b>85</b>
<b>Appendix A</b>	<b>.....</b>	<b>87</b>
<b>Appendix B</b>	<b>.....</b>	<b>101</b>

**List of Figures**

n	Figure 1.1 Industrial Development in the Kwinana Industrial Area.....	following page 2
n	Figure 1.2 Map of the Study Area showing Participating Kwinana Industries.....	following page 4
n	Figure 3.1 Existing and Potential Interactions between Kwinana	

Industries ..... following page 10

n Figure 3.2 Imports, Exports and Transactions for the Kwinana  
 Industries ..... following page 10

n Figure 3.3 Interaction Map of the Existing and Potential Kwinana  
 Industries from 1990 ..... following page 10

n Figure 3.4 Interaction Map of Existing Kwinana Industries  
 in 2000..... following page 10

n Figure 3.5 Interaction Map of the Existing and Potential Kwinana  
 Industries for the Future ..... following page 10

n Figure 3.6 Some of the Major Studies carried out in the Kwinana  
 Industrial Area over the Last Decade ..... following page 14

n Figure 3.7 Kwinana Industrial Area – Vacant Land ..... following page 18

n Figure 5.1 Annual Maximum Measured 1 Hour Average Ground  
 Level Concentration of Sulphur Dioxide Recorded at the  
 Department of Environmental Protection’s Wattleup Monitoring  
 Station ..... on page 51

n Figure 5.2 Annual Maximum Measured 1 Hour Average Ground  
 Level Concentration of Sulphur Dioxide Recorded at the  
 Department of Environmental Protection’s Hope Valley  
 Monitoring Station ..... on page 51

n Figure 5.3 Annual Maximum Measured 1 Hour Average Ground  
 Level Concentration of Sulphur Dioxide Recorded at  
 the Department of Environmental Protection’s Rockingham  
 Monitoring Station ..... on page 52

n Figure 6.1 Full Time and Part Time Employees By Category ..... on page 62

n Figure 6.2 Direct Employment over Time ..... on page 65

n Figure 6.3 Age Distribution of Full Time and Part Time  
 Employees ..... on page 67

n Figure 6.4 Percent Dollar Value by Type of Community Program .. on page 71

**List of Tables**

n Table ES.1 Summary of Existing and Potential Economic Benefits ..... ii

n Table ES.2 Summary of Factor Income and Planned Capital Expenditure ..... ii

n Table ES.3 Comparison of Results with 1990 Kwinana Heavy Industry  
 Study ..... iii

n Table ES.4 Summary of Kwinana Industries and Interactions ..... iii

n Table ES.5 Factors to Maintain Industries’ Comparative Advantage  
 (Managers)..... v

n Table ES.6 Factors to Maintain Industries’ Comparative Advantage  
 (Government)..... v

n Table 2.1 Summary of Respondent Kwinana Industries ..... 6

n Table 3.1 Summary of Industries and Interactions between Kwinana  
 Industries ..... 11

n Table 3.2 Summary of Land Availability Within the Kwinana Industrial  
 Area ..... 18

n Table 4.1 Where Kwinana Industries Sold their Output in 1999-00..... 23

n Table 4.2 Sales, Purchases and Factor Incomes Generated by Kwinana  
 Industry in 1999-00 ..... 24

n Table 4.3 Full Time and Part Time Employment by Industry Groups,  
 June 2000 ..... 25

n Table 4.4 Employment in Directly Related Establishments Owned by

	the Kwinana Companies and Located Elsewhere in Western Australia .....	25
n	Table 4.5 Capital Investment Undertaken in Kwinana 1995-96 to 2000-01...	26
n	Table 4.6 Capital Expenditure in 1999-00 by Type of Capital Goods Purchased and Regional Source of Supply (\$M). .....	26
n	Table 4.7 Illustration of the Multiplier Effects for a 10% Increase in Final Demand for Kwinana Industry Production Across all Industries in Western Australia.....	28
n	Table 4.8 Output, Earnings and Employment Multipliers for Kwinana Industries in 1999-00 .....	28
n	Table 4.9: Comparison of Type I Industry Multipliers Obtained from this and Previous Studies .....	29
n	Table 4.10: Multipliers for the Port of Fremantle .....	29
n	Table 4.11 Direct and Indirect Effects of Capital Investment Undertaken by Kwinana Industries Annually (Based on Annual Average Investment for 1995-96 to 1999-00).....	29
n	Table 4.12 Summary of the Direct and Indirect Impact of Existing Kwinana Industries.....	30
n	Table 4.13 Comparison of Results with the 1990 Kwinana Heavy Industry Study .....	31
n	Table 4.14 Comparison of Multipliers with the 1990 Study.....	32
n	Table 4.15 Indicative Effects of a 10% Increase in Final Demands for Kwinana Industries Output on the Australian Economy as a Whole. ....	32
n	Table 4.16 Contribution of Kwinana Industry to the Australian Balance of Trade .....	33
n	Table 4.17 Factors Mentioned as Working for Lower Production Costs at Kwinana .....	34
n	Table 4.18 Risk Factors for Higher Production Costs at Kwinana .....	34
n	Table 4.19 Average Ratings of the Significance of Factors Influencing the Future Level of Output.....	35
n	Table 4.20 Key Australian Macro-Economic Factors Affecting Kwinana Industries.....	35
n	Table 4.21 Influence of International Factors .....	36
n	Table 4.22 Key Uncertainties Facing Kwinana Industries.....	37
n	Table 4.23 Capacity Utilisation in 2001 .....	37
n	Table 4.24 Growth Plans for the Next 10 Years .....	38
n	Table 4.25 Types of Capacity Upgrades and Plant Productivity Improvements Planned .....	38
n	Table 4.26 Planned Capital Investment in the Next 5 and 10 Years.....	39
n	Table 4.27 Estimated Total Economic Impacts of the Expected Expansions of Output within Existing Kwinana Industries, for the Next 5 and 10 Years.....	39
n	Table 4.28 Indicative Economic Impact of Planned Capital Investment by Existing Kwinana Industries for the Period 2000/01-2005/6. The Impacts are Expressed as Annual Averages.....	40
n	Table 4.29 Estimated Potential Capital Expenditure, Total Output and Employment in Developments with Known Proponents: Direct Impact by 2009-10. ....	41
n	Table 4.30 Estimated Potential Impacts on Annual Output, Wages and Salaries, and Employment, if all Projects with Known Proponents were to Proceed by 2009-10.....	41
n	Table 4.31 Potential Impact of Capital Investment in Known Potential	

	Projects (Impacts are Expressed as Annual Average Impacts over a Ten Year Period) .....	41
n	Table 4.32 Summary of Potential New Plants Based on Future Technical Evolution of the Kwinana Industrial Complex (No Current Proponents) .....	42
n	Table 4.33 Value of Output, Employee Earnings and Employment that could be Generated by Exploiting Opportunities Identified by SKM for Further Technical Evolution of the Kwinana Industrial Complex .....	43
n	Table 4.34 Indicative Annual Average Economic Impact of Capital Investment Required for Exploiting New Technical Opportunities (the Estimates Assume that the Investment would be Spread over a Ten Year Period) .....	43
n	Table 4.35 Summary of Existing and Potential Economic Impacts .....	44
n	Table 6.1 Full Time Employment – Excluding Contractors .....	60
n	Table 6.2 Part Time Employment – Excluding Contractors .....	60
n	Table 6.3 Number of Apprenticeships and Traineeships .....	61
n	Table 6.4 Type of Apprenticeship/Traineeship .....	62
n	Table 6.5 Number of Establishments, Wages/Salaries and Total Employment in Related Organisations Located Outside the CRKLA Area ...	62
n	Table 6.6 Full time and Part time (excluding contractors) .....	63
n	Table 6.7 History of Traineeships .....	63
n	Table 6.8 Factors Affecting Future Employment Levels .....	65
n	Table 6.9 Age of Employees .....	65
n	Table 6.10 Key Trends in Workforce Profile .....	66
n	Table 6.11 Employee Residences .....	67
n	Table 6.12 Method of Travel .....	68
n	Table 6.13 Employee Services .....	68
n	Table 6.14 Support Options for Employees with Family Commitments .....	69
n	Table 6.15 Liaison and Consultation Policies .....	69
n	Table 6.16 Community Programs – Dollar Value - Year Ending June 2000..	69
n	Table 6.17 Community Programs – Locality of Recipients .....	70
n	Table 6.18 Companies Collecting Information on Community Perception....	71
n	Table 6.19 Number of People Consulted on Community Issues .....	71
n	Table 6.20 Most Used Community Information Gathering Techniques .....	72
n	Table 6.21 Tracking of Community Perceptions .....	72
n	Table 6.22 Complaints Systems .....	72
n	Table 6.23 Trends in Community Relationships .....	73
n	Table 6.24 Collection or Review of Community Profiles .....	73
n	Table 6.25 Existence of Decommissioning Policies .....	73

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# 1. Introduction

The Kwinana Industrial Area (KIA) was established in the early 1950s when the Western Australian Government negotiated an agreement with the Anglo Iranian Oil company, now B.P. Refinery (Kwinana) Pty Ltd, to construct an oil refinery. The agreement was formalised with the signing of the *Oil Refinery Act 1952*, and the rezoning of about 2,400 ha of coastal land for industrial purposes. This agreement fulfilled a major objective of the Western Australian Government, which was to establish an industrial base for the State's economy.

Over the proceeding years the KIA became the State's primary area of industrial development, with major drivers being it's proximity to the sheltered waters of Cockburn Sound, a ready supply of labour from Perth and Fremantle, and a willingness by the government to develop a dedicated heavy industrial area. **Figure 1.1** maps out the industrial development of the KIA over time.

By the early 1990s, public debate on environmental issues at Kwinana had become prominent. Some sections of the community were opposing proposals for new heavy industry and the government had released for public comment the EPA's *Draft Environmental Protection Policy (EPP) for Sulphur Dioxide and Dust in the Kwinana Region* (EPA, 1989) and *Draft Regional Environmental and Development Study Improvement Plan 14 (IP14)* (Dames & Moore, 1990a).

At this time the *Kwinana Heavy Industry Economic Impact Study* (Dames & Moore, 1990b) was commissioned by the then Confederation of Western Australian Industry (CWAI). The objective of this study was to ensure that the economic benefits created by the KIA were fully understood and included in public discussions in relation to the IP14 document. The conclusions of this study were that Kwinana is an important economic contributor to the State's economy with considerable potential for upstream and downstream integration.

Since 1990, while there has been some ongoing development in the KIA, the driving forces determining further expansion have changed. The government has investigated and created alternative heavy industry locations in Western Australia and community expectations related to environmental performance have grown along with increased environmental regulation.

This report has been commissioned by the Kwinana Industries Council (KIC) and the Chamber of Commerce and Industry of WA (CCI), and also supported by government agencies, to provide an enhanced update of the 1990 economic impact study, to collate financial, social, material and energy data related to the KIA and to provide the following outputs:

- To quantify the direct and indirect economic and social importance of Kwinana industries to the local, Western Australian and Australian communities;
- To Identify innovative development options, and to quantify the benefit of additional industrial and port development, subject to new planning initiatives and land availability;
- To identify positive community impacts which flow from the KIA, such as training and educational schemes; and
- To determine opportunities for sustainable industrial development through a review of the current interactions between industries and the identification of potential new resource saving and pollution prevention opportunities for integration.

This report will be used for a number of purposes, including:

- To promote the importance of the KIA;
- To serve as a reference document for CCI/KIC submissions;
- To provide an overview of social and environmental issues to the public;
- To assist in communication between existing industries;

- To provide an input/output database so that a wider audience can identify opportunities for synergy between industries;
- To inform potential new industries; and
- To provide an important reference for State government.

This study was based on comprehensive data and opinion obtained from Kwinana industries, support industries, government planning bodies and other interested parties. The bulk of information was obtained through a questionnaire that was distributed to 35 Kwinana industries. The following 28 companies responded to the questionnaire:

- |  |   |
|--|---|
| □ Air Liquide WA Pty Ltd                                   | □ Fremantle Port Authority  |
| □ Alcoa World Alumina Australia                            | □ Millennium Performance Chemicals<br>(Advanced Ceramics) Pty Ltd |
| □ Australian Fused Materials Pty Ltd                       | □ Nufarm Australia Limited  |
| □ Aventis CropScience Pty Ltd                              | □ Nufarm-Coogee Pty Ltd   |
| □ BHP Transport and Land Logistics Pty Ltd                 | □ OneSteel Market Mills   |
| □ BOC Gases Australia Ltd, Kwinana Bulk<br>Production Site | □ Shinagawa Thermal Ceramics Pty Ltd                              |
| □ BP Refinery (Kwinana) Pty Ltd                            | □ Summit Fertilizers  |
| □ CBI Constructors Pty Ltd                                 | □ Tiwest Joint Venture  |
| □ CIBA Specialty Chemicals Pty Limited                     | □ Transfield SMP  |
| □ Cockburn Cement Limited                                  | □ Tyco Water Pty Ltd  |
| □ Coogee Chemicals Pty Ltd                                 | □ WMC Kwinana Nickel Refinery                                     |
| □ Co-operative Bulk Handling Ltd                           | □ Water Corporation   |
| □ Edison Mission Energy                                    | □ Wesfarmers CSBP Limited   |
|  | □ Wesfarmers LPG Pty Ltd  |
|  | □ Western Power Corporation Kwinana Power<br>Station              |

The response rate to the questionnaire (80%) was very good, and it is expected that the findings and conclusions reported are conservative, but representative of the Kwinana industries in general.

In addition, consultation meetings and telephone discussions were held with the following major industries, government departments, government trading enterprises and local Authorities:

**Industries**

- ☐ Air Liquide WA Pty Ltd
- ☐ Alcoa World Alumina Australia
- ☐ BP Refinery (Kwinana) Pty Ltd
- ☐ James Point Pty Ltd
- ☐ Millennium Performance Chemicals (Advanced Ceramics) Pty Ltd
- ☐ Nufarm Australia Limited
- ☐ WMC Kwinana Nickel Refinery
- ☐ Wesfarmers CSBP Limited
- ☐ Other industries that wish their projects to remain confidential

**Government Departments**

- ☐ LandCorp – Industrial Operations
- ☐ Department for Planning and Infrastructure – Strategic Planning Division
- ☐ Department of Mineral and Petroleum Resources - Office of Major Projects

**Government Trading Enterprises**

- ☐ Western Power – Generation Division
- ☐ Water Corporation

**Local Authorities**

- ☐ Town of Kwinana
- ☐ City of Rockingham
- ☐ City of Cockburn

**Figure 1.2** shows the boundary of existing industrial zoned land in Kwinana (including areas zoned for transport and port infrastructure), used as the boundary for determining the economic and social impacts of the KIA. The location of the participating industries is also indicated. Cockburn Cement, whilst not located within the KIA, was included in the study because of its membership of the KIC and its importance as a heavy process industry interacting with many of the Kwinana industries. This approach is consistent with Cockburn Cement's inclusion within the Kwinana buffer zone.

Sponsorship for this study was provided by the following organisations:

- ☐ KIC;
- ☐ CCI;
- ☐ LandCorp;
- ☐ Department of Mineral and Petroleum Resources - Office of Major Projects;
- ☐ Department for Planning and Infrastructure – Strategic Planning Division; and
- ☐ Environment Australia.

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## 2. Existing Kwinana Industrial Area

### 2.1 Introduction

The industrial development within the Kwinana region consists of a highly diverse range of industries from smaller service industries, such as fabrication and construction facilities, through to very large heavy process industries, such as the alumina, nickel and oil refineries.

With the assistance of the CCI and the KIC, 35 industries were identified to participate in the study and 28 industries responded to the questionnaire. To assist in understanding the key interactions, industries have been categorised into the following: core process / support / infrastructure. This categorisation is not definitive, as some of the industries could equally be included in a different category.

**Table 2.1** provides a brief summary of the participant industries and their main products. Also included in this table is an indication of the industry's size within the KIA in terms of production capacity and the number of employees. The main products of each industry and the Australia and New Zealand Standard Industrial Classification (ANZSIC) code for that generic industry are included to provide an overview of their operations. The number of employees is a total for the organisation for operations within the Cockburn, Rockingham and Kwinana Local Authority Area (CRKLA) (as at 30 June 2000).

n **Table 2.1 Summary of Respondent Kwinana Industries**

Name	Main Products	ANZSIC code	Design Capacity	Licensed Capacity	No of Employees
<b>Core Process Industries</b>					
Air Liquide WA Pty Ltd	Industrial gases	253	300 t/d O <sub>2</sub> 430 t/d N <sub>2</sub> 12 t/d Ar	300 t/d O <sub>2</sub> 430 t/d N <sub>2</sub> 12 t/d Ar	6
Alcoa World Alumina Australia	Alumina	272	5.6 kt/d	N/A	959
Australian Fused Materials Pty Ltd	White fused alumina and fused zirconia	272 253	28.2 kt/yr	30 kt/yr	70
Aventis CropScience Pty Ltd	Agricultural chemicals	254	3.5 ML/yr	10 ML/yr	11
BOC Gases Australia Ltd, Kwinana Bulk Production Site	Industrial gases	253	-	-	18
BP Refinery (Kwinana) Pty Ltd	Petroleum products	251	135,000 bbl/d	Varies by unit	440
CIBA Specialty Chemicals Pty Ltd	Flocculents, dispersants and coagulants	253 254	20 kt/yr	10 kt/yr	40
Cockburn Cement Limited	Lime and Cement	263	850 kt/yr	800 kt/yr	362
Coogee Chemicals Limited	Inorganic chemicals and tank terminal	253 670	-	-	143
Co-operative Bulk Handling Ltd	Grain storage and ship loading	630 670	-	-	95
Millennium Performance Chemicals (Advanced Ceramics) Pty Ltd	High purity zirconia powders	253	600 t/yr of zirconia powder	25 kt/yr on mineral sand milling capacity not zirconia powder production	17
Nufarm Australia Limited	Agricultural chemicals	254	-	-	72
Nufarm-Coogee Pty Ltd	Chlorine, caustic soda, sodium hypochlorite and hydrochloric acid	253	-	-	17
OneSteel Market Mills	Patio tubing	27	50%	-	18
Shinagawa Thermal Ceramics Pty Ltd	Refractory	262	-	3 kt/yr	5
Summit Fertilizers	Fertilizers	253	250 kt/yr	-	30
Tiwest Joint Venture	Titanium dioxide pigment	253	92 kt/yr	180 kt/yr	277
Tyco Water Pty Ltd	Steel pipe	370	20 kt/yr	N/A	29
WMC Kwinana Nickel Refinery	Nickel metal	272	67 kt/yr	75 kt/yr	240
Wesfarmers CSBP Limited	Fertilizers, ammonia, ammonium nitrate, sodium cyanide, and industrial chemicals	253	1,000 kt/yr 220 kt/yr 200 kt/yr 45 kt/yr	- 220 kt/yr 200 kt/yr 45 kt/yr	414
Wesfarmers LPG Pty Ltd	LPG	251	250 kt/yr	300 kt/yr	42
<b>Infrastructure and Utilities</b>					
Edison Mission Energy	Electrical and thermal energy	361	116 MW 2.8 kt/d steam	-	19
Fremantle Port Authority	Shipping and bulk port installations	630 644	-	-	26*
Water Corporation	Water supply and treatment	370	-	-	13*
Western Power Corporation Kwinana Power Station	Electrical energy	361	900 MW	900 MW	167
<b>Support Industries</b>					
BHP Transport and Land Logistics Pty Ltd	Transport and freight services	611 620 630	-	-	67
CBI Constructors Pty Ltd	Fabrication and equipment warehouse	286	N/A	N/A	3
Transfield SMP	Structural steel fabrication	41 27	-	-	36
				Total	3,636

\* Employees nominally servicing the Kwinana facilities.

## 2.2 Core Process Industries

The core process industries include those industries that would generally be considered as chemical, petroleum or mineral processing industries. These industries represent an important core group for the purpose of identifying potential synergies between existing industries and opportunities for synergy with new industries. A key point about these industries is that their products or by-products may be used by other process industries as raw materials and, if appropriately co-located, such material interaction may be facilitated through dedicated conveying technology such as pipelines or belt conveyors.

## 2.3 Infrastructure and Utilities

The infrastructure and utilities industries provide the critical foundations for the continued industrial development of the Kwinana area and often service Western Australia beyond the KIA.

The infrastructure and utilities category includes:

- Port facilities;
- Power stations;
- Scheme water provision; and
- Wastewater collection and treatment.

These industries generally have limited “process” interactions with the other Kwinana industries beyond their core service provision.

## 2.4 Support Industries

The support industries are those industries that, whilst providing an essential service to the area, are not considered so much as process industries but rather as service providers. These include the fabrication and construction industries for new plant manufacture and installation, and the provision of trade labour for maintenance activities that are essential to most of the core process and infrastructure industries within Kwinana and elsewhere.

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## 3. Potential Industrial Development

### 3.1 Introduction

An important intermediate goal for this study was the identification of opportunities for new industrial developments within the KIA. These opportunities are transient in nature for the following reasons:

- The demand for products and services may be filled by an industry existing within, or new to, another industrial area or overseas that has a comparative advantage over any existing or potential Kwinana industry;
- The demand for products and services may be filled by a substitute product; and
- Industry proposals and the industries themselves are in a continual state of flux dictated by the laws of supply and demand, and the knowledge and abilities of the entrepreneurs who propose new industries.

The main reasons for inclusion of potential industries in this study are:

- To predict the economic impact of a potential industrial mix for Kwinana; and
- To highlight opportunities for the existing industries to undertake greater trade between themselves.

To determine a future scenario for industrial development within the Kwinana area, several issues were considered:

- Existing and potential interactions between existing industries, which were used to identify supply and demand options within the KIA that are not capitalised on currently;
- Environmental and social constraints that must be met by industry;
- Land availability in total and also in terms of the size of individual lots; and
- Regional planning to ensure that future industry fits the development objectives of State and local government.

### 3.2 Development Prospects

#### 3.2.1 Existing Synergies Between Industries

A key objective of the study was to identify and map the significant process interactions between the core process industries within the KIA.

A summary interaction table is provided as **Figure 3.1**. The vertical axis shows the source industries (“sellers”) and the horizontal axis shows the destination industries (“buyers”) for materials. The existing interactions are displayed in blue. Potential interactions are displayed as black cross-hatching. Where an industry has existing and potential interactions, this is denoted by a blue background with black cross-hatching. It should be noted that the interactions do not include all of the industries in the Kwinana study area, only those that participated in the survey.

**Figure 3.2** summarises these interactions in terms of the chemical imports, exports and transfers involving Kwinana industries. For this figure, imports and exports are defined as crossing the boundary of the study area. Order of magnitude quantities have been provided in the figure to protect the commercial confidentiality of the participating Kwinana industries. These quantities have been collated from accurate, and commercially sensitive, purchasing and sales data supplied by participating industries. In some cases (sometimes associated with commercial confidentiality), the location of the supplier or customer has not been provided by the industry. These are described in the boxes labelled “Unspecified Source” and “Unspecified Destination” respectively.

When considering the complexity of interactions between the Kwinana industries it is useful to view a flow chart of the interconnections. The increase in complexity of and interdependency of the Kwinana industries is obvious by comparison of the interaction map from the 1990 economic impact study (**Figure 3.3**) with the existing interactions for the year 2000 (**Figure 3.4**). Some of the increased complexity is the result of a greater level of detail being investigated in the 2000 study: more industries were studied and the industries provided more detail on minor product streams. However, it is evident that the degree of interaction has increased significantly over the 11 years, reflecting increasing interdependency and the need for greater interaction between the industries to maintain their comparative advantages in production and ensure their longevity within the Kwinana area.

The recent survey indicates that in 2000 there were 68 transactions identified between the core process industries. Nine interactions were identified where the core process industries supplied a product to the infrastructure and utility sector, with a further three interactions of core process industries supplying products to the support industries.

The infrastructure and utility sector and support industries provide numerous services to the core process industries. Of these, the Kwinana Power Station (Western Power), Fremantle Port Authority and Water Corporation can, or do, have interactions with all of the Kwinana industries through their mandated roles of service providers. Many of these interactions have not been specifically identified through the survey. Edison Mission Energy provides energy to the BP Refinery (Kwinana).

### **3.2.2 Opportunities for Synergies Between Existing Industries**

Survey respondents were requested to provide an indication of further potential interactions between Kwinana industries. As discussed in **Section 3.2.1**, these potential interactions are reflected as cross-hatching on the interaction map of **Figure 3.1**. From **Figure 3.1** 55 potential new interactions have been identified between the core process industries. A further five interactions could occur from the core process industries to the infrastructure and utilities sector and two more potential interactions were identified from the core process industries to the support industries.

Opportunities identified typically included straight purchase of products or services between industries. This was especially the case for the support industries that would like a greater share of work available within the Kwinana area. The fabricators raised a concern over the loss of skills in the Kwinana area and their ability to service the area into the future, due to the recent downturn in resource development activity and the impact of awarding some fabrication projects to overseas firms based on low cost.

**Figure 3.5** shows the existing and potential interactions between Kwinana industries for the future. The new industries that have been included on **Figure 3.5** seem likely to proceed in the future, and are predicted to have a large impact on production and employment within the Kwinana area. These impacts are discussed further in **Section 4.7**. Numerous other industries could have been included but are not considered to be as likely to meet these criteria.

A more innovative possible interaction is the Waterlink project which has seen industries and the Water Corporation co-operate on a project to replace scheme water with treated wastewater for process applications where appropriate. More details on the Waterlink project are provided in **Section 5.4** on Water Conservation.

Given the range of chemicals being bought, sold and consumed by the Kwinana industries, there appears to be several areas where synergies may be possible:

- Economies of scale by a single user importing (to the Kwinana area) a commodity and on-selling to other users either “as is” or in diluted form. Examples include caustic soda and sulphuric acid

- that are raw materials to several industries in varying concentrations. (Caustic soda is already produced within the KIA, however production is far less than demand);
- Further processing of materials to meet small scale needs, replacing imports. Examples include the manufacture of activated alumina or petroleum coke to meet local needs;
  - Joint ventures to minimise costs through better asset utilisation. An example would be a method to better co-ordinate transport requirements to best utilise the available transport. This could include a real time register of transport requirements to try and utilise trucking for “backloads” especially for materials coming from, or going to, regional areas. Alternatively, this could be handled on an individual industry basis. One such interaction was identified by a respondent;
  - It may be possible to utilise waste heat from numerous existing facilities, either internally in their own processes, or in neighbouring industries. This would depend on the heat content of the exhaust streams and specific process heating requirements;
  - Associated with the above point on waste heat, is the potential for collection of condensate from exhaust streams. This may provide some opportunity to reduce demand on water resources for process water; and
  - Gypsum production (10-100 ktpa) possibly through lime scrubbing of sulphuric acid gases.

Data collected through the survey was insufficient to evaluate opportunities for waste heat and condensate recovery, as this was not a consideration in the project scope.

**Table 3.1** summarises the existing and potential interactions between the existing Kwinana industries. It should be noted that the current study was more extensive than the 1990 study, resulting in some of the growth in the number of industries and interactions. This growth becomes evident when comparing **Figure 3.3** to **Figure 3.4**.

n **Table 3.1 Summary of Industries and Interactions between Kwinana Industries**

	<b>1990 Study</b>	<b>Current Study</b>
Existing Core Process Industries	13	21
Existing Service and Infrastructure Industries	Not Studied	7
<b>Total Industries Studied</b>	13	28
Existing Interactions between Core Process Industries	27	68
Additional Existing Interactions Considering Service and Infrastructure Industries	Not Studied	38
<b>Total Existing Interactions</b>		106
Potential Interactions between Existing Core Process Industries	2	55
Additional Potential Interactions Considering Existing Service and Infrastructure Industries	Not Studied	49
<b>Total Potential Interactions</b>		104

### 3.3 Opportunities for New Industries

Several methods were used to determine opportunities for new industries within the Kwinana area. These included a review of project lists published over time in the *Prospect Magazine* produced by the Department of Mineral and Petroleum Resources' Office of Major Projects, consideration of opportunities raised specifically by respondent industries and Government Departments, and consideration of opportunities from the purchase and sales data provided by the Kwinana industries.

Coogee Chemicals Pty Ltd has received Works Approval for the construction of a 55,000 tonne per annum aluminium fluoride plant at Kwinana. Commercial factors will determine the final timing of this project.

Western Power Corporation has commenced civil works for the construction of a new power station at Kwinana on the site of the existing Kwinana Power Station, as a replacement for the existing Kwinana Stage B Power Station. Known as the Cockburn Power Station, the new power station will utilise high efficiency gas-fired combined cycle plant to provide a nominal 240MW of electricity.

#### 3.3.1 Projects Seeking Approvals

Global Olivine Western Australia has proposed a Waste to Energy and Water Plant for Kwinana. This plant will accept and incinerate waste materials, especially municipal wastes, to generate energy and water. This will help reduce disposal of wastes to landfill.

James Point Pty Ltd has proposed a private port for the region. This port would initially handle much of the livestock export currently shipped through the Port of Fremantle, with plans to expand into bulk and general cargo. The Fremantle Port Authority is also planning future port developments in Kwinana.

Rio Tinto Ltd recently announced plans to proceed with feasibility studies for their proposed Hismelt pig iron plant which is valued at \$400M. This project is expected to produce 820,000 tonnes per annum of pig iron from the first stage, with a further 820,000 tonnes per annum planned with the second stage of the project. The project is undergoing a formal Public Environmental Review Process.

#### 3.3.2 Projects in Feasibility Stages

Western Power is investigating the feasibility of a gas turbine power station of up to 1,800 MW in the Kwinana Industrial Area as part of its Power Procurement Process. A strategic environmental review of this concept is underway with formal public review expected in late May.

Alichem Pty Ltd has announced plans for a 40,000 tonne per annum aluminium fluoride plant at Kwinana.

Water Corporation has plans for the construction of the Kwinana Water Recycling Project, which has resulted from the Waterlink project (see **Section 5.4**).

Water Corporation is also investigating the construction of a 100 megalitre per day Reverse Osmosis Seawater Desalination Plant in the Perth metropolitan area, as part of the Water Corporation's drought response strategy. This project could be located within the Kwinana area, if it is approved for construction.

Further power generation facilities are expected within the Kwinana area. There are a number of possible proponents for such facilities, with potential facilities ranging from relatively small co-

generation plants through to large scale electricity generation facilities based on natural gas or liquid fuels.

Coogee Chemicals Pty Ltd has announced plans for a zeolite production facility within Kwinana. There are several other projects that are in the feasibility stages; however, these projects are confidential at present.

Two other significant projects that have been previously considered for the Kwinana region are the East Rockingham Steel/Direct Reduction Iron plant by Compact Steel Pty Ltd (feasibility study in 1993) and the Petrochemical Complex promoted by Petroleum Industries Company (Environmental Review in 1987). Neither of these specific projects seems likely to progress in the Kwinana region.

### 3.3.3 Opportunities Identified through the Study

The opportunities for new industries within the Kwinana area are typically limited by the availability of land and supporting infrastructure and services, lack of international competitiveness, government attitudes and regulations, and the synergies that are possible for the industry in a given location.

A review of the process inputs imported into the KIA from **Figure 3.2** identifies some potential opportunities for new industries to locate in Kwinana and achieve synergies with existing industries. It should be noted that these potential opportunities are based on a review of local supply and demand in the KIA only. This analysis does not consider other economic factors, such as the state of international markets and projected trends in supply and demand, which are necessary to determine whether any such potential opportunities are economically feasible. Potential industrial opportunities include:

- Caustic soda production (100-1,000 ktpa demand) - this could be through a chlor-alkali plant(s).
- Phosphates and potash (100-1,000 ktpa demand) used for fertilizer manufacture.
- Activated alumina (10-100 ktpa demand) which could be produced using alumina from Alcoa World Alumina Australia.
- Petroleum coke (10-100 ktpa demand) which may be a potential product from the heavy ends of the petroleum refining process operated by BP Refinery (Kwinana) Pty Ltd.
- Gypsum (10-100 ktpa demand). This may be possible to produce within Kwinana from sulphuric acid gas scrubbing using lime from Cockburn Cement Limited. However, there appears to be other gypsum projects in Western Australia such as Lake Macleod.
- Ferrous Sulphate (10-100 ktpa demand).

Other potential manufacturing opportunities that were mentioned as potential industries by respondents include:

- Aluminium chloride (note that aluminium chloride is already produced and exported out of the Kwinana area in small quantities).
- Zirconium chemicals (e.g. zirconium oxychloride).
- Titanium production from titanium dioxide produced by the Tiwest Joint Venture.
- Acrylonitrile. Acrylonitrile is a fundamental building block for the production of synthetic materials. The survey respondent believed that if acrylonitrile was locally available, his organisation would consider purchasing in the order of 1-10 ktpa in the next five years and increasing to 10-20 ktpa thereafter. As acrylonitrile is produced from catalytic air oxidation of propylene and ammonia, there would be a potential synergy with the ammonia production capacity existing at Kwinana.

The production of caustic soda through chlor-alkali plants could open up a range of new products and opportunities, such as chlorine production. While chlorine supply approximately meets current demand, at least one industry has considered extending its use of downstream products from chlorine production, if those products were available. The Australian transport regulations restricting bulk

transport of chlorine was a concern raised in the survey, adding to the desirability for further chlorine production within the Kwinana area if demand increased.

It should be mentioned that some of these inputs are supplied from organisations within the Perth metropolitan area or the rest of Western Australia. In at least one case, the above material is supplied from another division of the parent company within Western Australia, reducing the potential for a new industry at Kwinana. Determining the impact and desirability of new industries in these cases was beyond the scope of this study. Similarly, it has been assumed that when a source or destination was classed as “unspecified” in **Figure 3.2**, the source or destination location was outside the KIA. This situation possibly provides an opportunity within the KIA.

It may be viable to create new industries around some of the smaller demand specialty chemicals, such as zirconium oxychloride (<1 ktpa reported) used in mineral sands processing. These opportunities have not been evaluated in detail, as the quantities appear too small for profitable manufacture unless significant export markets could be developed.

The value of the potential industries identified through the survey of material requirements is estimated to be in the vicinity of \$80M per annum. The real value of these projects to the economy if they proceeded would be significantly more because of the need for plants to achieve the necessary economies of scale to compete internationally and through the economic multipliers discussed in **Section 4**. It should be noted that many of these industries may not be commercially feasible due to international market considerations or environmental and social constraints. Evaluating the potential and feasibility of these industries was beyond the scope of this study.

### 3.4 Opportunities and Constraints to Future Development

This section of the report provides a summary and history of the planning, infrastructure, environmental and land availability opportunities and constraints that will affect the potential industrial development in the KIA. It does not attempt to analyse these issues in depth, but rather to provide the background to assumptions which were used to estimate the environmental performance, economic impact and social benefits of existing and future industrial development. This summary also aims to capture the changes in these constraints over time.

The KIA is well serviced by water, electricity, gas and port facilities. These infrastructure facilities do not constrain the further development of industries within the KIA. However, the changing and growing needs of the Kwinana industries in the future will require good coordination and management of such facilities to ensure that they do not become a constraint on the future development of the area.

#### 3.4.1 Regional Planning Opportunities and Constraints

As the primary industrial area for Perth and Western Australia, the KIA has been the subject of many strategic planning studies over the years. These studies have included the following:

- Dames & Moore (1991). *East Rockingham Industrial Park Strategic Development Plan*. Report prepared for the Kwinana Industries Co-ordinating Committee;
- Dames and Moore (1996). *Towards Optimising Kwinana*. Report prepared for the Kwinana Industries Co-ordinating Committee;
- Arup (1999). *Kwinana Central Core Development Strategy – Master Plan*. Report prepared for the Department of Resources Development; and
- ERM et al (2000). *Fremantle-Rockingham Industrial Area Regional Strategy*. Report prepared for the Western Australian Planning Commission.

The boundaries of these studies are shown in **Figure 3.6**.

The purpose of the *East Rockingham Industrial Park Strategic Development Plan* was to optimise the use of available land in the IP14 study area by heavy, light and general industry, given environmental factors, community requirements and infrastructure constraints. However, this land remains largely undeveloped today.

The mission of the *Towards Optimising Kwinana* study was “to build a world class industrial area and a prosperous community and to create space for export industry”. To progress towards this mission, the study contained 63 recommendations that included improved infrastructure and waste management strategies, and social and environmental issues.

Following the release of the *Towards Optimising Kwinana* report, the Kwinana Industries Co-ordinating Committee established a working group to develop an action plan for implementing the recommendations of the study. The Kwinana Central Core was identified as requiring priority attention due to substantial parcels of under-utilised land in private and Government ownership. *The Kwinana Central Core Development Strategy Master Plan* was developed to build on the principles identified in *Towards Optimising Kwinana* for this area. This report again considered in greater detail, land availability and infrastructure requirements.

The most significant regional planning document currently affecting the KIA and surrounding CRKLA is the *Fremantle Rockingham Industrial Area Regional Strategy (FRIARS)*, prepared by the Western Australian Planning Commission to enable the Government to provide strategic land use planning for the Fremantle-Rockingham region for the next 20-25 years. The most significant recommendations of the study are the allocation of coastal area for private port facilities, identification of transport corridors within and surrounding the KIA and the identification of a total of 896 ha of land currently within the Kwinana EPP buffer to be rezoned for industrial use. In the context of this study, the participating industries were asked to indicate the extent to which the different elements of FRIARS will impact on the future development of their operations. The responses to these questions have been captured in the following sections:

☐ Section 3.4.2 Infrastructure and Services Opportunities and Constraints.

☐ Section 3.3.3 Opportunities Identified through the Study.

Flowing on from the FRIARS study is the Hope Valley-Wattleup Redevelopment Project Master Plan. This Master Plan, which is in development, takes the recommendations from FRIARS and develops them into an action plan for implementation.

### 3.4.2 Infrastructure and Services Opportunities and Constraints

The industry participants of this survey were asked for their opinion on strategic issues for the KIA. Whilst the Kwinana area is well serviced through existing infrastructure, the changing and growing needs of the Kwinana industries have led to several themes being raised through the questionnaire. Many of these issues have been addressed to some extent in various planning studies and documents, of which the *Fremantle-Rockingham Industrial Area Regional Strategy* (WAPC, 2000) is an example.

The main themes expressed by the respondents were as follows:

- In relation to the proposed port facilities, 12 industries indicated a local port is important, while 13 indicated a local port would have little or no impact on their operations. (This generally refers to container and general cargo facilities – see below for more discussion on ports.) Concerns raised included the increased environmental pressure that would be placed on Cockburn Sound, restricted access to the Sound for industry and the public and concern about additional vehicle movement to and from a new port.
- The need to maintain heavy load and Dangerous Goods transport routes was stressed, along with a need for Anketell Road to be upgraded if additional port facilities are built.

The opportunities and constraints in relation to new industries are further discussed below.

#### **Ports**

The main issue facing the development of ports in Cockburn Sound, is the long-term strategic need for increased general cargo and container transport, as the Fremantle Port Inner Harbour reaches full capacity. This need will be picked up in the Outer Harbour (Cockburn Sound) by either government managed or private port facilities. If this requirement is not managed effectively, it is possible that industries in the KIA who currently use Fremantle Port for general cargo and container transport will suffer delays due to congestion.

New industries requiring dedicated facilities and considering locating in the KIA, or existing industries wishing to expand, will be competing with the need for general port facilities (i.e. competition related to dredging for shipping channels and environmental impacts related to interference with sand drifts etc). It is likely that these competition issues would be lessened if installations for new industries could be added to the existing Fremantle Port Authority or proposed private port facilities.

New industries which require ocean intakes or outfalls will also find that physical and logistical constraints for piping access to the Sound will increase. These constraints will be in addition to constraints created by the increasing community concern and environmental legislation related to wastewater outfalls into the Sound.

#### **Railways**

The KIA is served by the dual gauge freight system maintained and operated by the Australian Railroad Group. From the Kwinana Yard and Locomotive depot, lines exist to serve several industries in the KIA, from Alcoa in the north to CBH in the south. Industries seeking rail transport could locate into the existing lines or negotiate an extension to their site. The requirements for minimum tonnages will govern the commercial arrangements for rail access.

#### **Road**

The land use planning for the KIA includes the creation of new west-east linkages to the Kwinana Freeway and access towards Armadale. Further major road links are planned to the growing residential areas of Byford and Mundijong. Generally, the major road issue is to ensure road routes for oversize loads are secured. This requirement has been incorporated into the Main Roads transport planning. For

hazardous loads, route planning will need to consider the constraint imposed by residential properties along main roads. Comprehensive risk analysis and contingency planning would be required.

### ***Infrastructure Services***

The service infrastructure planning for the KIA has essentially been completed for a number of years. Historically, main services have been gathered into corridors that particularly facilitate the distribution of electric power. It can be generally stated that the area is serviced subject to particular requirements of individual sites which can be resolved by negotiation with service utilities.

A concern of the service utilities is the construction of services for relatively large land parcels which, due to partial use of the land, are under-utilised. Particularly in the early development phase, this results in low returns on capital investment. Discussions are in progress to derive a procedure whereby land title can be created with servicing constructed on a needs basis to reduce capital requirements.

The Kwinana area is well serviced by water services infrastructure, including potable (scheme) water supplied by the Water Corporation, which is licensed by the Office of Water Regulation to provide potable water services, non-potable water services, wastewater and drainage services for the area. The area also has limited underground water resources, which are licensed by the Water and Rivers Commission.

The WaterLink project is being progressed by the Water Corporation to achieve better water efficiency and environmental management through a cooperative approach involving several major industries in the KIA. This project is discussed further in **Section 5.4**.

### **3.4.3 Land Availability for Industries**

It is envisaged that most new heavy industries would require at least 10 ha of land, with some industries requiring significantly more.

To determine the amount of land available for potential new industries, an initial review of aerial photography (1999) of the KIA was performed to identify vacant parcels of land. The boundaries of vacant areas were determined, along with ownership and these vacant parcels have been mapped in **Figure 3.7**. A total of 63 parcels were identified, of these 21 are greater than 10 ha.

Through the study questionnaire, industries were asked to identify any land that may become available for sale. The responses indicated that many of the existing Kwinana industries have significant land holdings that are not currently utilised, but are not available for sale to new industries. These land holdings are being reserved by the respective industries for their future expansion plans (“brownfield” development sites), for internal buffering or in one case to maintain an access route. Of the 28 companies participating, only three indicated land holdings which will likely become available for a new industry in the next 10 years. This corresponds to approximately 213 ha within the KIA boundary. Of this land, some is already utilised by industries under a lease agreement. The vacant land estimated to become available for new industrial developments is approximately 90 ha. Of this, there are four lots above 10 ha, all within the Central Core, being sites 4, 5, 6 and 8 as shown in **Figure 3.7**.

A total of 763 ha of government owned vacant land is in the KIA. Of this there are 15 lots greater than 10 ha, although several adjoining lots could form a total area >10 ha. Some of these areas have been allocated for infrastructure and it is estimated that 13 lots >10 ha are available. The majority of this land lies at the southern end of the KIA, in the East Rockingham Industrial Park. The *East Rockingham Industrial Park Strategic Development Plan* (Dames & Moore, 1991) also identified the southern portion of this area for general industrial use and the northern for heavy industrial development. Despite this and subsequent planning documents, this area has remained largely vacant.

Discussions with government planning agencies during this study have indicated that the planning strategies for the government owned land are in a state of flux. In the past, large blocks of vacant land have been reserved for “heavy industry”, being large mineral processing industries, with significant emission of wastes and high societal risk. With the improvement in environmental emission control technology, environmental impacts from heavy industry have been reduced and the difference between general and heavy industry is becoming less clear. In addition, the concept of retaining large portions of land for heavy industry is being challenged, especially in areas where community concerns are strong, such as the East Rockingham Industrial Park.

Both the greenfield and brownfield sites have been included in the future scenario of the economic analyses of **Section 4**.

**Table 3.2 Summary of Land Availability Within the Kwinana Industrial Area**

Ownership	Vacant Land		Potential Available Land	
	Total Area	# Lots >10 ha	Total Area	# Lots >10 ha
Private	237	6	85 <sup>1</sup>	4
Government	763	15	730 <sup>2</sup>	14
Total	1000	21	815	18

Note:

1. As indicated by industries participating in the study.
2. Assumed all land available except for areas designated as parkland buffer.

### 3.4.4 Environmental and Social Opportunities and Constraints

Since the early 1990s, environmental issues have become an increasingly important consideration for any organisation planning to develop a new industry within Kwinana or expand existing operations.

Initial environmental concerns related to air quality, with sulphur dioxide and total particulates being of primary concern. In response to these concerns, the *Environmental Protection (Kwinana) (Atmospheric Wastes) Policy* (Environmental Protection Authority, 1992) was promulgated.

It should be noted that while air quality issues were an early constraint on industrial development of the KIA, the focus and importance of environmental constraints has broadened significantly over the last decade. Much effort has recently been directed towards noise impact assessment and mitigation in response to increasing public concern and the release of *Environmental Protection (Noise) Regulations 1997* (Environmental Protection Authority, 1997.)

Discussions during the consultation stage of this study indicated that some industries with ocean outfalls are planning capital investment to reduce or remove releases to Cockburn Sound.

In an aim to ensure the environmental values of Cockburn Sound are maintained, the EPA has recently released the *Draft Environmental Protection (Cockburn Sound) Policy, 2001*.

Organisations planning expansion or new industries considering locating in the KIA will need to address issues such as:

- Air quality;
- Noise;
- Public safety;
- Wastewater and solid waste disposal;
- Water supply options;
- Groundwater management and contamination; and
- Releases that may affect Cockburn Sound.

The Kwinana industries, either individually, or collectively within the Kwinana Industries Council, are addressing many of the above environmental issues, and have been proactive in working with government agencies in developing appropriate regulations, guidelines and management plans to ensure the future quality of the environment in Kwinana and the metropolitan areas. To date several industries have received recognition for their proactive approaches to environmental management (see **Section 5** for more details).

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