Water Authority
of Western Australia

Kemerton Industrial Park Water Source and Effluent Disposal Assessment

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Report No. WP 99
January 1991

Water Authority
of Western Australia

WATER RESOURCES DIRECTORATE
Water Resources Planning Branch

Kemerton Industrial Park

Water Source and Effluent Disposal

Assessment

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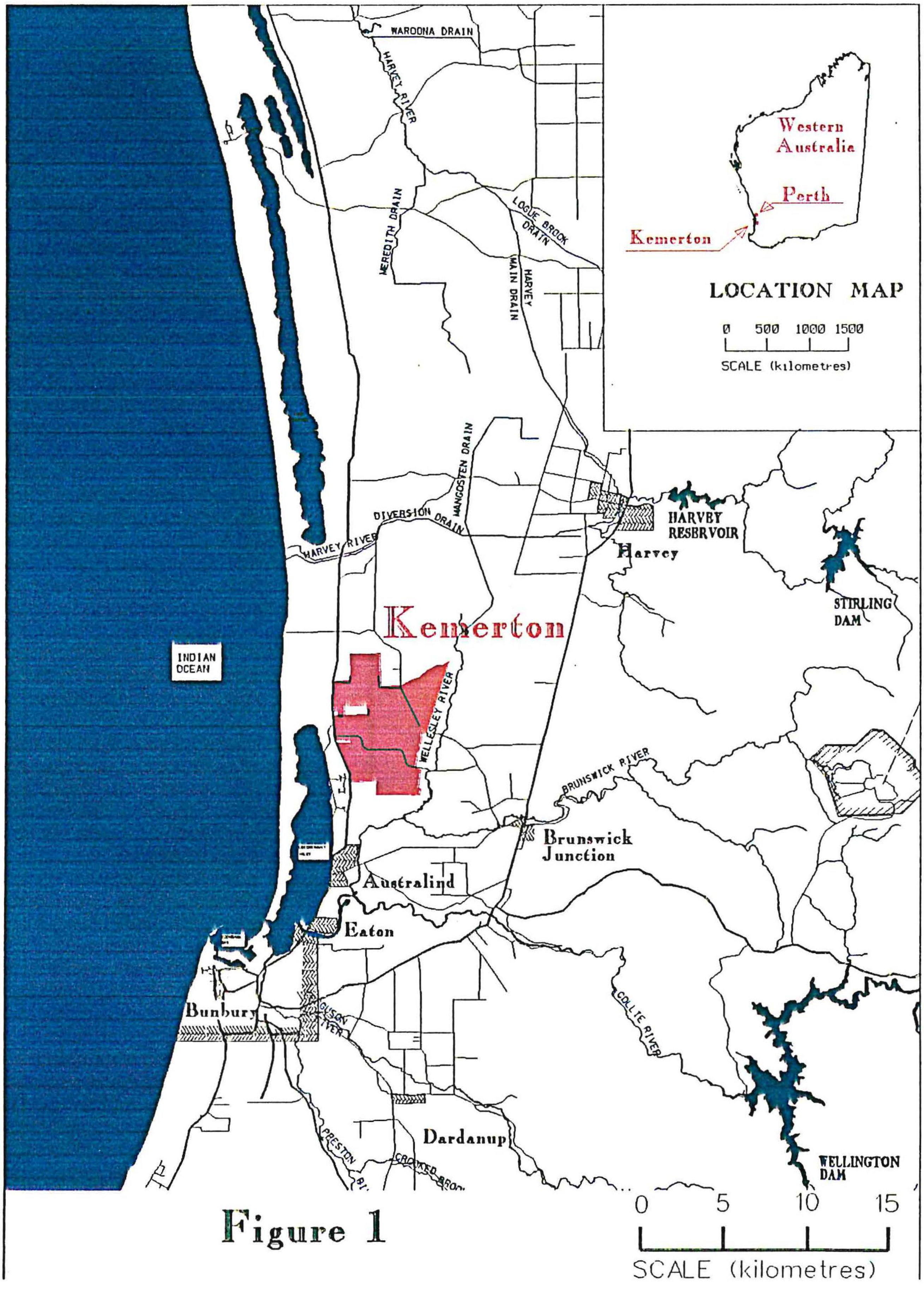

Figure 1

KEMERTON INDUSTRIAL PARK
WATER SOURCE AND
EFFLUENT DISPOSAL
ASSESSMENT.

1.0 INTRODUCTION

In 1983 the Bunbury 2000 document was released as the basis for a strategy to accelerate the social and economic development of the Bunbury and South-West region. The Bunbury 2000 development programme and the State Planning Commission "Bunbury Region Plan" (State Planning Commission, 1983) recommend that general and heavy industry be encouraged to develop in the Bunbury region.

Industrial development will require development of new water sources. Industrial growth will be accompanied by population growth which will further impact on available water resources. Domestic and industrial water demand is therefore expected to increase significantly in the region by 2020.

The Southwest Strategy released by the South West Development Authority (SWDA) in June 1988 acknowledges the future industrial development of the region as being of prime importance. The Bunbury Region Plan stipulates four areas as the prime growth areas for industry. These are: the Port of Bunbury, Picton, Davenport and Kemerton. Kemerton Industrial Park is developing as the regional centre for heavy industry. The location of Kemerton is shown on Figure 1.

Industries currently operating in Kemerton include the Goodchilds Abattoir, the Australind Piggery, SCM Chemicals, and Barrack Silicon. The Kemerton Industrial Parklands report (Feilman Planning Consultants, 1988) identifies several industries which may consider establishing in Kemerton and assesses their impact on the region. A Structure Plan was developed which would accommodate the probable ultimate Kemerton development in a parklands environment. Figure 2 shows the overall theme of this structure plan.

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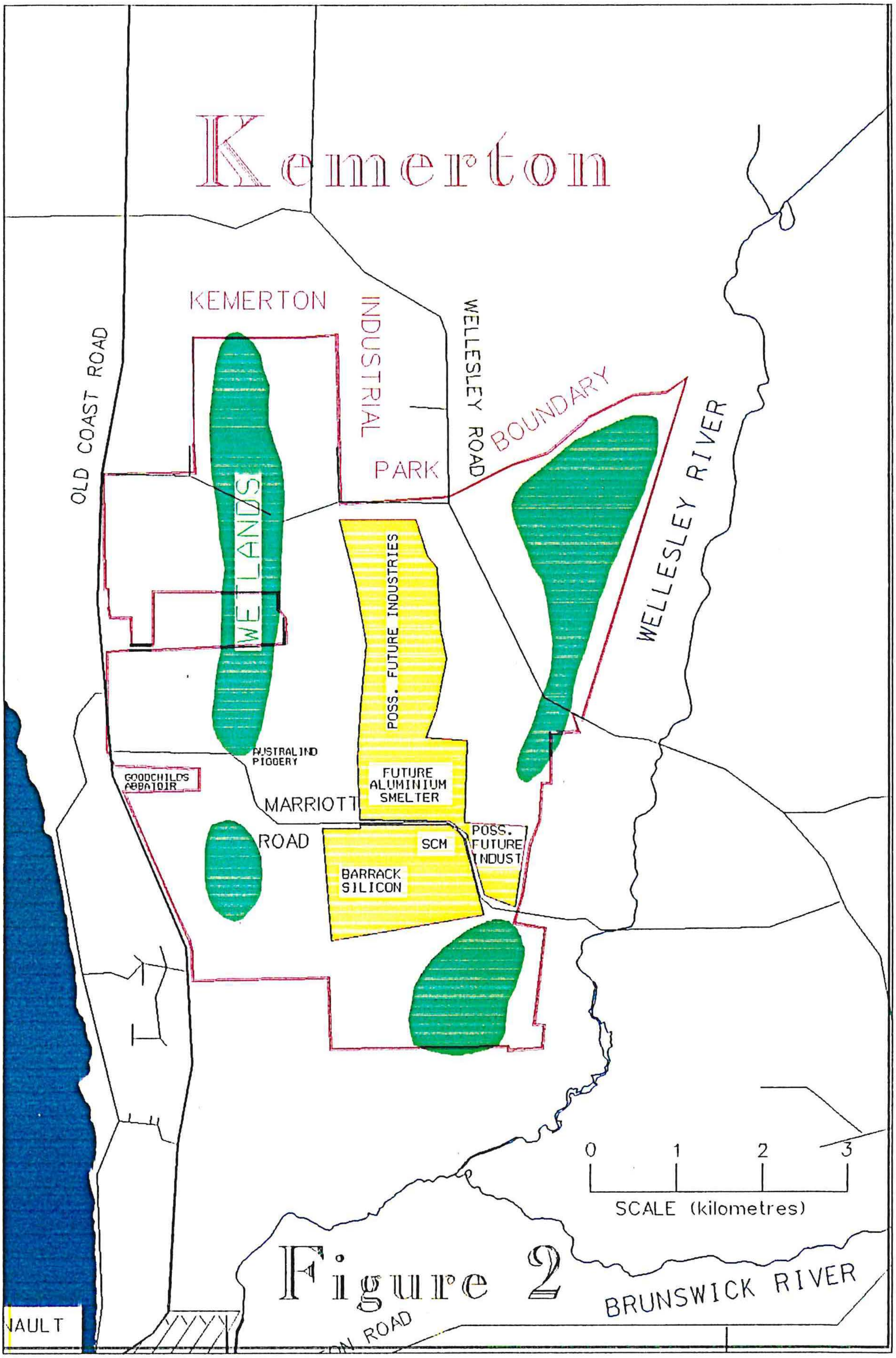

Figure 2

2.0 SCOPE OF THIS REPORT

The Department of Resources Development (DRD) has identified several industries which may establish in Kemerton. The Water Authority has been requested to investigate water supply and effluent disposal schemes which would meet the needs of these future and existing industries (DRD letter dated 11 October 1990). It is recognised that the capacity of the existing groundwater sources and the effluent disposal scheme at Kemerton are limited.

This report outlines options for water supply and effluent disposal and provides preliminary costing information for use in preparing early budgets. The costing information presented is based on conceptual designs.

3.0 FORECAST DEMAND

DRD is currently negotiating with Tioxide Ltd who are considering the possibility of developing a new pigment plant at Kemerton.

DRD has provided the following as the most likely industries to develop in Kemerton:

Industry	Water Demand (million cubic metres per annum)
Australind Piggery (exist.)	0.02
Goodchilds Abattoir (exist.)	0.33
SCM Chemicals(existing)	1.8
Extension to SCM (double)	1.5
Move SCM Australind to Kemerton	0.6
Barrack Silicon (existing)	0.4
Extension to Barrack Silicon	0.3
Tioxide pigment plant	2.7
Power Plant	0.4
Compact Steel Mill	0.5
Aluminium Smelter	1.8
TOTAL DEMAND	10.4 (say 10.0)

The Ministry of Economic Development has advised that there is a possibility that a pulp mill will develop on the site by 1998. If this occurs, demand would be tripled and new source development options would need to be investigated.

It is not possible at this stage to accurately predict the timing of the development of various industries in Kemerton. However, it is important to allow for some development schedule for the purpose of preparing cost estimates and for comparing Net Present Value (NPV) of various options. Therefore, for the purpose of this study it has been assumed that demand will increase in yearly increments of 1 million cubic metres per annum until the maximum projected demand is reached. The sensitivity of this assumption was checked, and if the rate of development were to be twice the assumed rate, overall costs would decrease by approximately 5%. Alternatively if the rate of development were to be half the assumed rate, overall costs would increase in the order of 10% above the costs shown in this report.

4.0 WATER QUALITY REQUIREMENTS

Water quality requirements vary from industry to industry. For many industries, much of the water is used for quenching and washdown activities where quality is not a major concern. Other uses such as production, process and boiler feed require high quality water.

Of the industries currently operating at Kemerton, Australind Piggery and Goodchilds Abattoir use water primarily for washdown and Barrack Silicon uses water primarily for quenching purposes. Most of the water used by SCM is drawn from a bore which produces 610 mg/l TDS. A portion of this water is treated for use in finishing processes.

Tioxide has advised that of an estimated 2.7 million cubic metres per annum water usage, approximately 1.0 million cu m pa of high quality water will be required(Tioxide letter dated 12 September 1990). It has been assumed for the purpose of this study that SCM requirements are in similar proportions to those of Tioxide.

Therefore, of the 5.3 million cubic metres per annum water currently in use (this figure includes the Tioxide proposal), 1.75 million cubic metres per annum (approximately 32%) must be of high quality. The balance may be of significantly lower quality (approximately 68% of the total). For the purpose of this study, it has been assumed that the proportions indicated will be the same for the total future demand of Kemerton.

5.0 ALTERNATIVE WATER SOURCES

Five sources were investigated to supply the future Kemerton demand. Existing industries obtain water from private bores, but this practice cannot be used by future industries as there is no additional groundwater available.

The sources which were investigated are summarised on Table 1

TABLE 1
SUMMARY OF SOURCES INVESTIGATED

COMPARISON OF WATER QUALITY FOR SOURCES

SOURCE	SALINITY (TSS mg/l)			COLOUR (hazen)			TURBIDITY (ntu)		
	average	max	min	average	max	min	average	max	min
Brunswick R	138	279	89	27	100	2	22	250	<1
Harvey Dam	185	332	93	15	90	2	5	16	1
Harvey Drain	189	501	99	94	470	5	40	100	1
Wellesley R	684	1346	461	111	160	60	51	120	9
Collie R	571	1435	106	10	43	5	1	5	<1

Local Groundwater 610 mg/l TDS 7.2 mg\l Iron

5.1 USE OF GROUNDWATER

Direct use of local groundwater and use of local groundwater conjunctively with surface sources were investigated as well as injecting surface water into the aquifers to increase sustainable yield.

5.1.1 INDIVIDUAL BORES

There is insufficient groundwater in the Kemerton/Australind area to support any new major industries. That portion of the groundwater which is not currently licensed is reserved for use by town water schemes.

This means that new industries moving into the area will not be able to use additional local groundwater.

5.1.2 INJECTION INTO AQUIFER

The concept of using one of the surface water sources and injecting water into the aquifers during the wet season and extracting it for use during the dry season was considered. It was decided that the risk of contaminating the aquifer with nutrients, pesticides or other pollutants would be quite high and that injection water would require some treatment prior to injection.

An additional concern is that, whereas, on an average annual basis, abstracted groundwater would be replaced by injected water, this would not be the case on a seasonal basis. A very real chance exists that water table levels would be lowered during the dry summer months. This would threaten conservation of the wetlands which flank Kemerton.

The cost of such a system would be similar to the costs of other systems for which risk to the integrity of the groundwater system and the associated wetlands is much less.

Two options for this system were investigated:

1. The first was to construct a pipehead on the Wellesley River which flows along the Eastern boundary of Kemerton. This option is shown on Figure 3. An injection borefield would be

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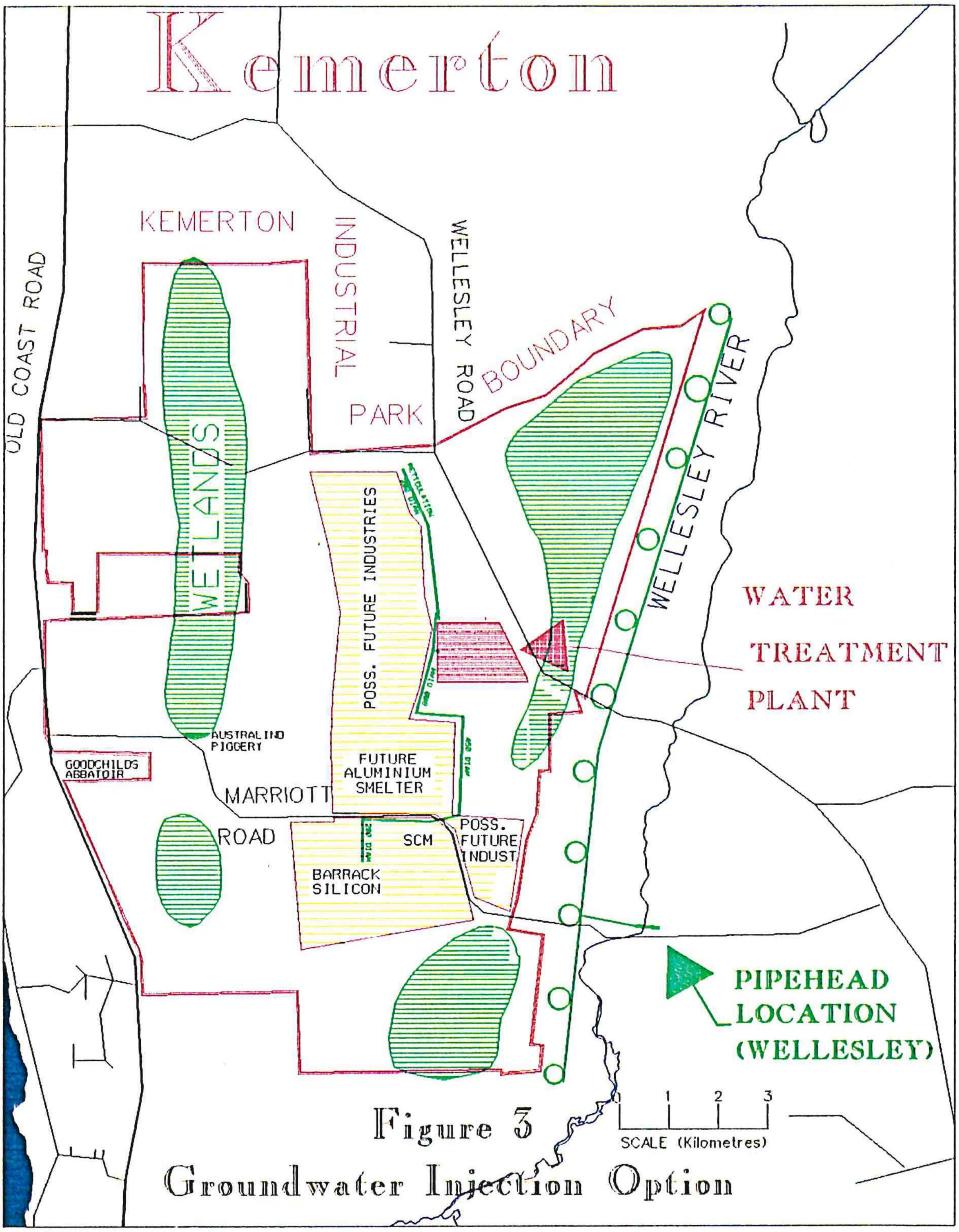

Figure 3

Groundwater Injection Option

constructed along the eastern boundary of Kemerton, and when the river flows, water would be captured at a pipehead and would be injected into the aquifers through a series of bores. This water would then be extracted through a bore field located to the west, and the water would be treated and reticulated. This option would cost in the order of 40 cents per kilolitre. It would produce sufficient water to meet demand for 76% of the time and would require restrictions, on the average, 3 months per year. This is only a marginal improvement over the option of conjunctive use of groundwater.

2. The second option which was investigated was to construct a pipehead on the Brunswick River and to pipe the water to a location upstream of the Kemerton abstraction borefield. Water would be captured at a pipehead and would be injected into the aquifers through a series of bores. This water would then be extracted through a bore field located along the Kemerton eastern boundary, and treated and reticulated. This option would cost in the order of 42 cents per kilolitre. It would produce sufficient water to meet demand for 78% of the time and would require restrictions, on the average, 2 months per year. This is also only marginally better than the option of conjunctive use of groundwater.

5.2 USE OF A DAM

The concept of using a dam is very attractive as security of supply is far better than for other options. On-going costs tend to be lower than for other options although capital costs are higher. A significant advantage is that treatment for iron, colour, turbidity, etc would be minimal for a system supplied by a dam.

5.2.1 CONSTRUCT A DAM ON THE BRUNSWICK RIVER

This option is shown on Figure 4. The construction of a dam on the Brunswick River was raised as a source possibility for a paper pulp mill which was being

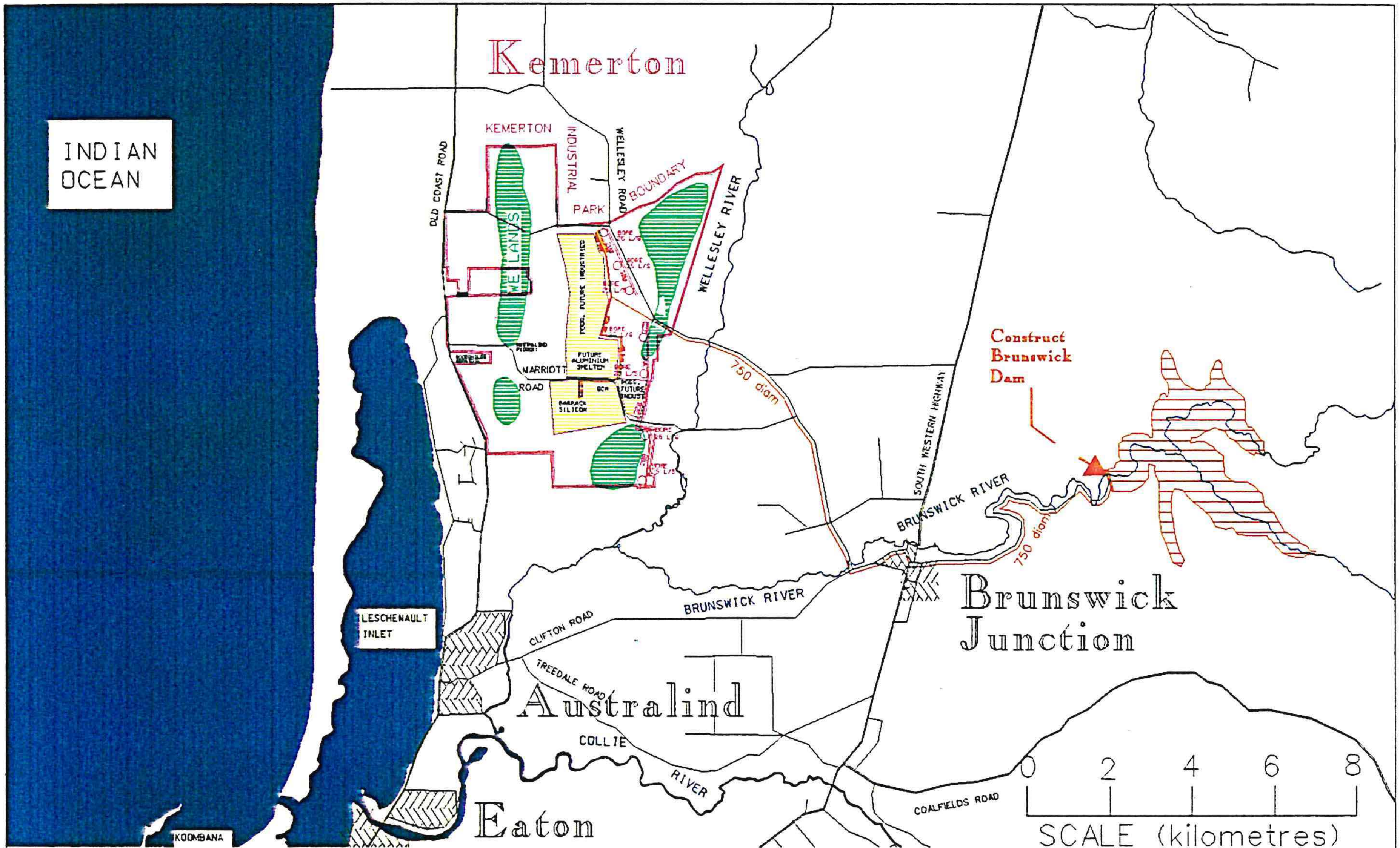

Figure 4 Brunswick Dam Option

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considered for Kemerton in 1989. The pulp mill required 21 million cubic metres of water per annum. This development is now considered as unlikely, and has not been included in this study.

A dam on the Brunswick River as shown on Figure 4 would provide a secure supply of water at an excellent quality with no treatment being required. The preferred site for a dam on the Brunswick River is at Olive Hill as other sites have significantly smaller catchments and correspondingly smaller yields. The Olive Hill site requires that, for a dam of any size, the railway must be relocated. This will cause a significant increase in cost and environmental and social impact.

A significant amount of public opposition could probably be expected towards construction of a dam on the Brunswick River. This opposition would be generally against a dam for any purpose and would be especially strong for construction of a dam for industrial supply.

The cost of this option at 46 cents per kilolitre is almost the highest investigated and is 50% more than the majority of the options that were investigated.

5.2.3 HARVEY DAM

This option proposes the use of the existing Harvey Dam water by extending a pipeline from the existing Harvey Irrigation pipe reticulation network to Kemerton as shown on Figure 5. It would also provide a secure supply and would require no treatment. At a cost of 26 cents per kilolitre, this is the most attractive option in terms of economics. The water quality averages about 200 mg/l and would be meet the high quality requirements of any industry proposing to move into Kemerton.

The problem with this source is that all water in the Harvey Dam is currently used by the Harvey Irrigation District irrigators. This water may become available to industry if existing irrigators cease to use their entitlements and if transferable water entitlements are allowed.

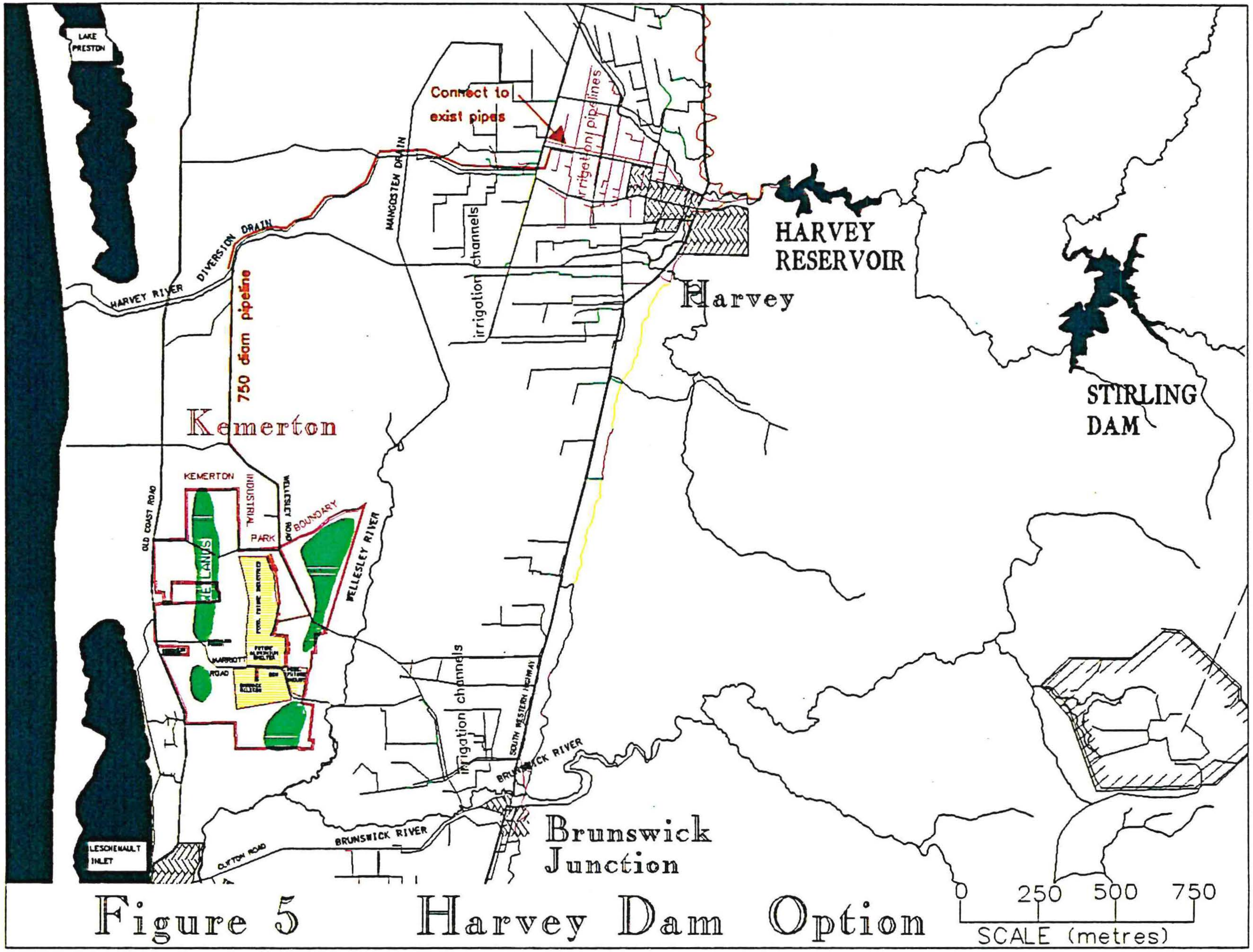

Figure 5 Harvey Dam Option

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The Irrigation Strategy Study - South West Western Australia (Water Authority, July 1990) has identified a trend to reduce the area of farmlands under irrigation. If these projections prove correct, it is anticipated that, in ten years, sufficient excess water may be available in the Harvey Dam to supply Kemerton's total demand.

The Industrial Lands Development Authority (ILDA) has recommended that such water be used to supply Kemerton (ILDA letter dated 31 October 1990). If this is to occur, current rules must be changed to allow for transfer of water entitlements.

Until the changes discussed above have occurred, the Harvey Dam cannot be considered as an available resource.

5.2.4 WELLINGTON DAM

The Wellington Dam must be considered as a very attractive option. A supply which is sourced in the Wellington Dam as shown on Figure 6 has the benefit of a secure supply. In addition, as opposed to the Harvey Dam, the water is immediately available. There is currently an allocation of 20 million cubic metres per annum in the Wellington Dam which has been allocated for use by industry. If the trends in irrigation usage continue as discussed above, the amount available to industry can be expected to increase.

Unfortunately, water in the Wellington Dam is adversely affected by salinisation of the catchment, and experiences salinity levels which are occasionally higher than 1400 mg/l. This is satisfactory for use in cooling and washdown activities as discussed in Section 4.0 of this study, but is possibly not satisfactory for use in approximately 30% of industry's water use.

Raw water can be delivered from Wellington Dam to Kemerton at approximately 17 cents per kilolitre. If a desalination plant were to be constructed and operated by the Water Authority, the cost of water treated to 250 mg/l would be in the order of 64 cents per kilolitre.

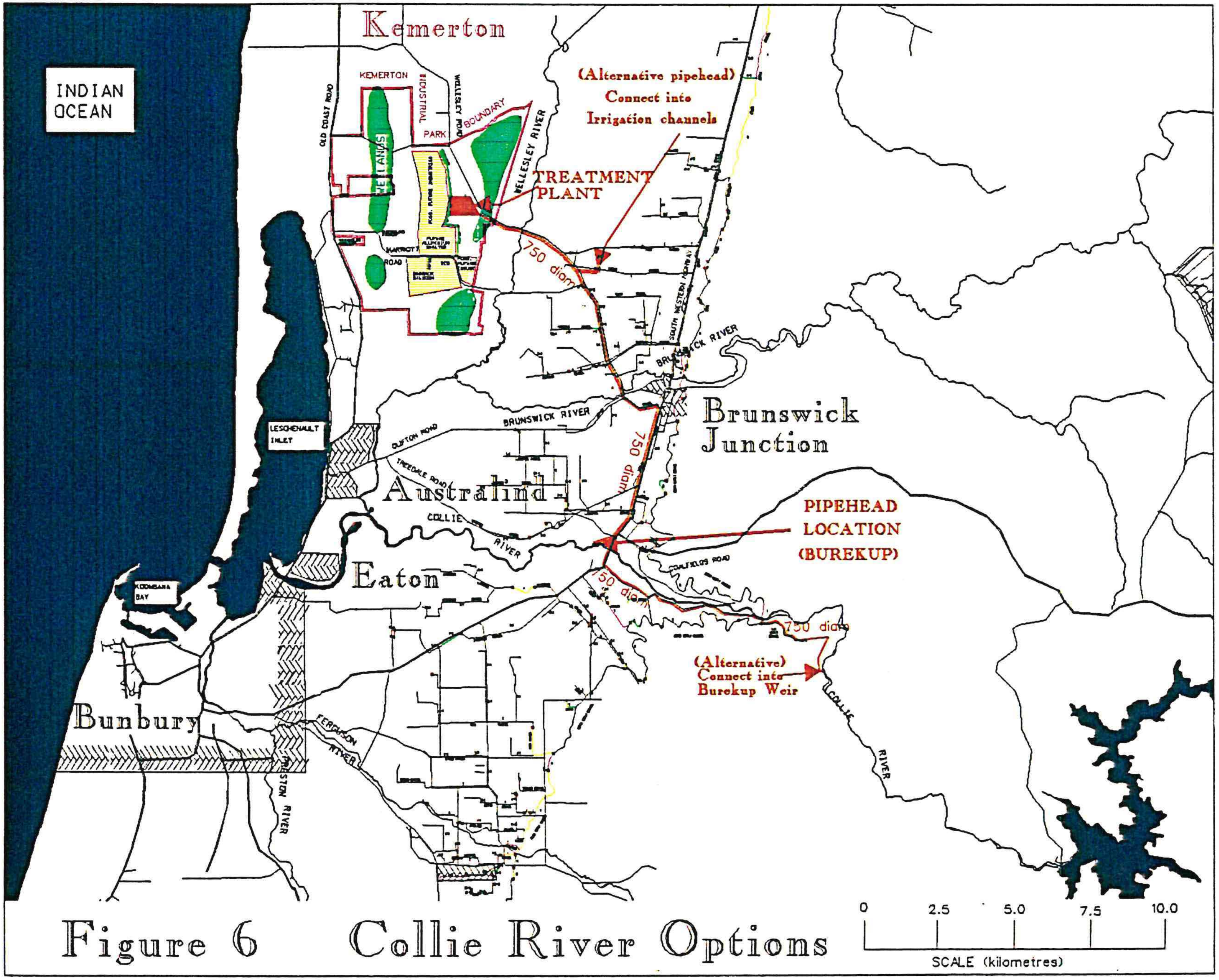

Figure 6 Collie River Options

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The cost to correct the salinity is relatively expensive, but if a dual reticulation system were to be constructed to supply 67% untreated water and 33% volume desalinated to 250 mg/l, water can be supplied at 34 cents per kilolitre overall. This supply can be treated as secure.

The Water Authority is conducting a catchment reforestation programme which is expected to bring the salinity down to satisfactory levels by 2010 (Wellington Dam Catchment Regeneration, Water Authority, 1988). This would mean that, although initial costs of desalination can be expected to be high (approximately $0.28 per kilolitre), they will be significantly reduced and possibly eliminated over time. Therefore the long term price for Wellington Dam water could drop to levels similar to that of water from the Harvey Dam.

The costs listed for the Wellington Dam options, however, take the conservative approach and ignore this possibility.

Several alternatives were investigated for use of Wellington Dam. These alternatives were:

1. Use Wellington Irrigation channels to bring the water to the Kemerton boundary. This alternative has the difficulty of down time required for channel maintenance. Therefore in order to provide year-round supply, on-site storage equal to 20 days demand must be constructed. The cost of this storage results in an overall cost higher than other Wellington Dam options.

   A possible variation to this alternative would be to install a pipehead on the Wellesley River to supply water during channel maintenance periods. This would cost approximately $1.0 million less than storage, but additional treatment facilities required to treat Wellesley River water for colour and turbidity would cost an extra $1.5 million which would make such a scheme less attractive than use of storage.

2 Construct a pipehead on the Collie River near Burekup to capture water released from the dam. This alternative is very attractive as it has a lower capital cost than other options. A further benefit is that it is independent of irrigation channel constraints and would not require any major on-site storage. It has the disadvantage that it requires a pump station to pump from the pipehead to Kemerton. The operations cost of a pump station make it less attractive than the third major alternative.

3 Construct a pipeline parallel to the main channels from the Irrigation District diversion weir. This pipeline will operate by gravity to Kemerton and, although the capital cost is significantly higher, the net present value is much lower. If the Wellington Dam option is selected, this is the alternative which would be preferred.

4 The above alternatives all assume use of a desalination which would provide a portion of the water supplied at a low salinity. A variation to this concept would be to construct a pipeline from the Brunswick to supply high quality demands while supplying raw Wellington water to the balance of Kemerton users. This would cost in the order of 44 cents per kilolitre overall and is thus less attractive than the preferred option.

5 If industries were given the option of treating their own water, they would have more control over the costs of treatment. The nature of current desalination technology gives a minimal economy of scale, and so the costs of desalination at a central facility would not be much different from the costs of several privately operated plants. An additional benefit of this concept would be that the second reticulation system would be no longer required. The cost savings would be in the order of $800,000.

Water could be delivered under this concept at approximately 17 cents per kilolitre.

Other options examined use run-of-the-river schemes with conjunctive use of groundwater.

5.3 RUN-OF-THE-RIVER SCHEMES

It was felt that a new dam may be too costly for Kemerton alone (as proposed for this study). Pipehead schemes were investigated for each of the three proposed surface sources.

Security of supply was checked using daily flow records for each resource. The results of these analyses are summarised on Tables 2 and 3.

5.3.1 PIPEHEAD ON THE BRUNSWICK RIVER WITH CONJUNCTIVE USE OF LOCAL GROUNDWATER

The use of a pipehead on the Brunswick River has the advantage of good quality water with a minimal environmental and social impact. This is shown on Figure 7. The Brunswick River water from a pipehead will require treatment for colour and turbidity.

The Brunswick does not flow year round and therefore a run-of-the-river scheme will be unable to produce water during the dry summer months. Conjunctive use of local groundwater is one solution to this problem. The groundwater will require treatment for iron removal and possibly for pH correction.

Two alternatives were investigated:

1. The first is to construct a pipehead at Olive Hill and to serve Kemerton by gravity. This has the benefit of reducing or eliminating pumping costs.

2. The second alternative is to construct a pipehead downstream from Brunswick Junction. This would require pumping to Kemerton. The disadvantage of this option is the on-going costs associated with pumping. The advantage of this option is reduced capital cost. The Net Present Value (NPV) of this option proved to be lower than for alternative 1.

A pipehead on the Brunswick River will meet Kemerton's demand 57% of the time and would be unable to supply sufficient quantities of water for five months per

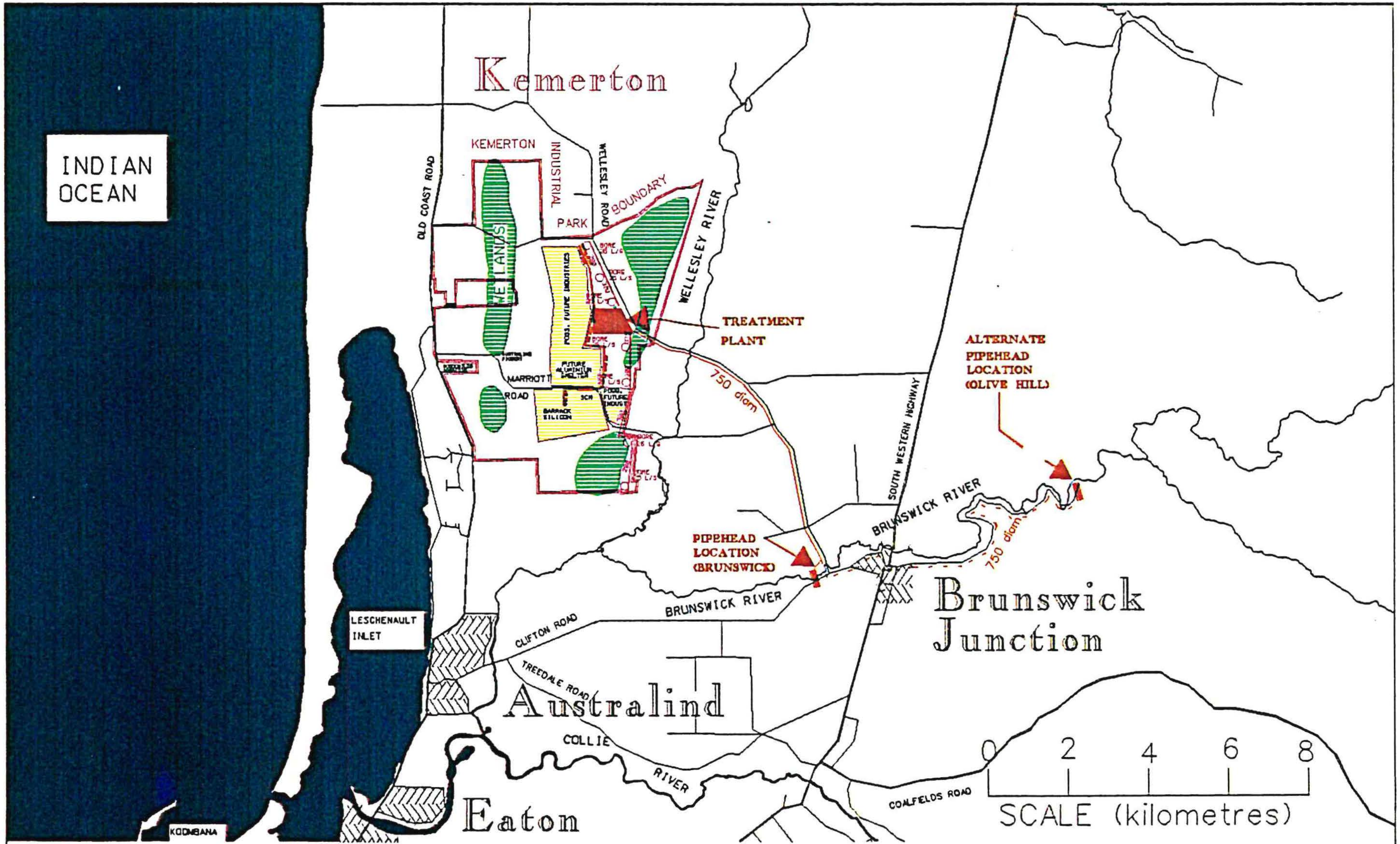

Figure 7 Brunswick Pipehead Options

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year. With conjunctive use of groundwater, the Brunswick pipehead scheme will meet Kemerton's demand 80% of the time. The scheme would not be able to supply full demand for an average of 2.5 months per year.

As discussed in Clause 5.1.1, there is insufficient groundwater to allow for new users. The only way for this scheme to have access to groundwater in sufficient quantities for conjunctive use is to transfer existing bore licenses to the scheme. Existing industries would then be required to connect to the new scheme.

The security of supply for this option would be unacceptable for use by industries.

This scheme would cost in the order of 27 cents per kilolitre.

5.3.2 PIPEHEAD ON THE HARVEY DIVERSION DRAIN WITH CONJUNCTIVE USE OF GROUNDWATER

Water from a pipehead on the Harvey Diversion Drain will require treatment for colour and turbidity. This option is shown on Figure 8. As for the Brunswick, a pipehead on the Harvey Drain will be unable to meet demand during the dry summer months. Conjunctive use of local groundwater is proposed to solve this problem. As for the Brunswick option, the groundwater will require treatment for iron removal and possibly for pH correction.

A portion of the flow in the Harvey Drain has been committed to be discharged into the Harvey Estuary as part of the nutrient level control programme for the Harvey Estuary. This is not in conflict with use by Kemerton as much of the time during the wet season, the pipehead will take only a small portion of the total flow downstream of the Harvey Dam. The amounts committed for nutrient control in the Harvey estuary can be released down the Harvey River at the same time.

A pipehead on the Harvey Drain would meet Kemerton's demand 39% of the time. With conjunctive use of groundwater, the scheme would meet Kemerton's demand 62% of the time. The scheme would not be able to

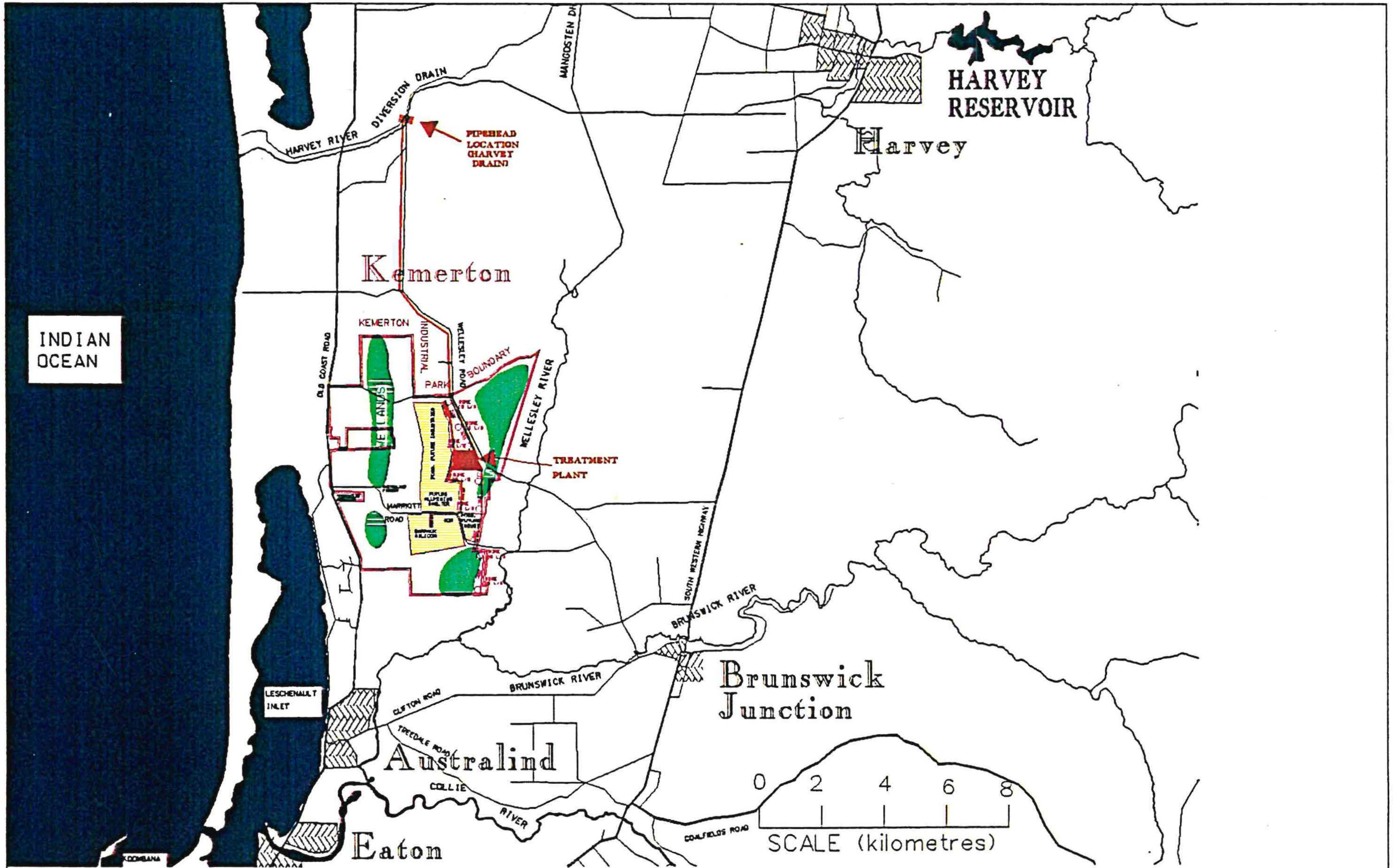

Figure 8 Harvey Diversion Drain option

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supply full demand for an average of 4.6 months per year every year.

It may be possible to improve this scheme's security of supply by releasing water from the dam during low flow periods. If this is to be possible, it would be necessary to transfer water entitlements or to lease water from farmers in the irrigation district.

As documented above, the only way for this scheme to have access to groundwater is to transfer existing bore licenses to the scheme.

The security of supply for this option would probably be unacceptable for use by industries.

This scheme would cost in the order of 32 cents per kilolitre.

5.3.3 PIPEHEAD ON THE WELLESLEY RIVER WITH CONJUNCTIVE USE OF GROUNDWATER

The main advantage of using the Wellesley River is its proximity to Kemerton. This option is shown on Figure 9.

The Wellesley River water from a pipehead will require treatment for colour and turbidity. As for the Brunswick and the Harvey Drain options, conjunctive use of groundwater would be required to maintain year-round service. The groundwater will require treatment for iron removal and possibly for pH correction.

A pipehead on the Wellesley River will meet Kemerton's demand 43% of the time. With conjunctive use of groundwater, the scheme will meet Kemerton's demand 62% of the time. The scheme would not be able to supply full demand for an average of 4.5 months per year every year.

As documented above, the only way for this scheme to have access to groundwater is to transfer existing bore licenses to the scheme.

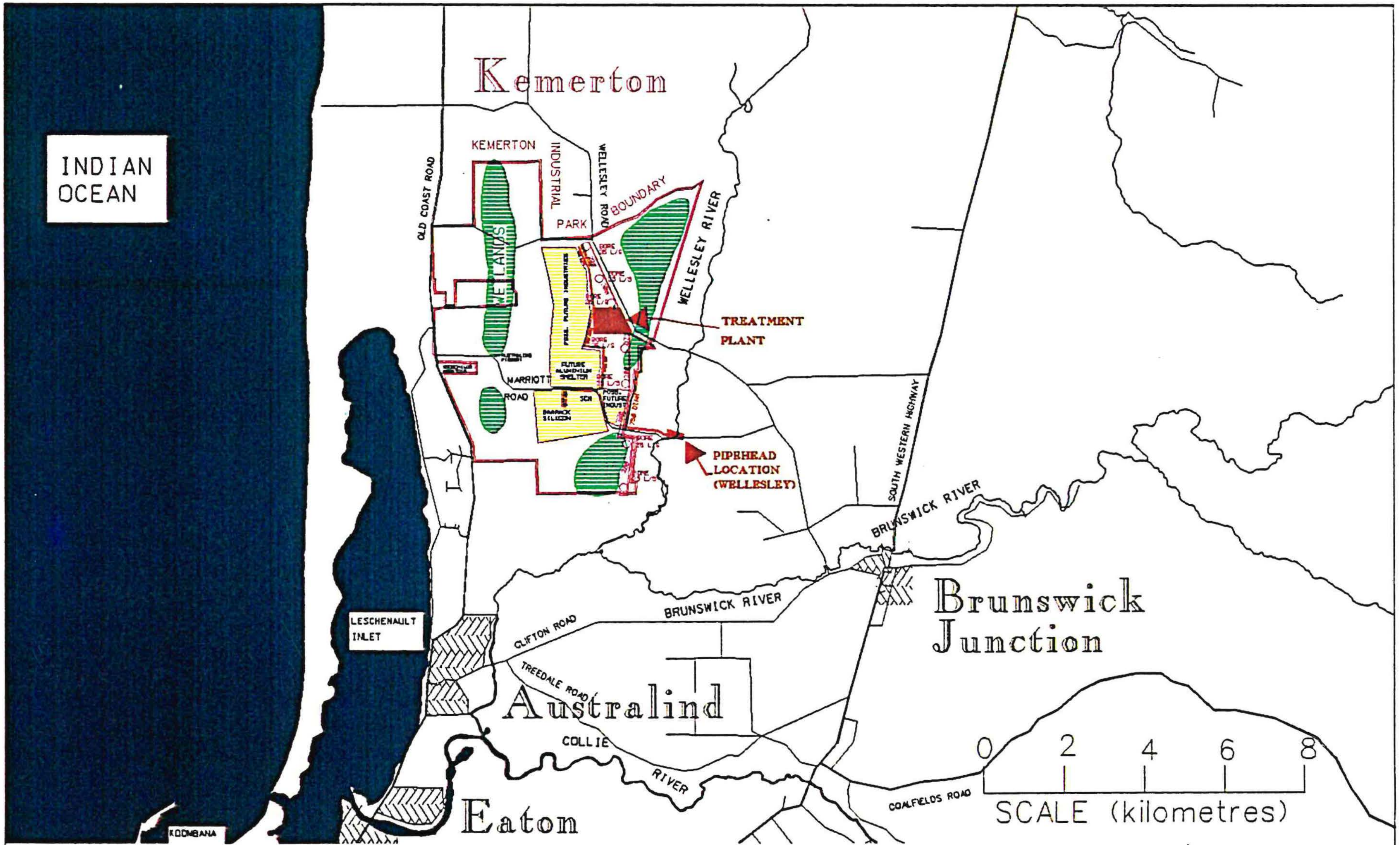

Figure 9 Wellesley River option

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It was felt that the security of supply for this option would probably be unacceptable for use by industries. This scheme would cost in the order of 25 cents per kilolitre.

As none of the run-of-the-river options discussed above are able to provide adequate security of supply, the balance of the options examined use multiple surface water sources with conjunctive use of groundwater.

5.3.4 PIPEHEAD ON THE HARVEY DRAIN AND A PIPEHEAD ON THE BRUNSWICK RIVER WITH CONJUNCTIVE USE OF GROUNDWATER

This option is for initial construction of a pipehead on the Harvey Drain coupled with conjunctive use of groundwater. This would be adequate for the first three years. In the fourth year, a pipehead would be constructed on the Brunswick River which would be used to augment the supply when there is insufficient flow in the Harvey Drain.

This option would require the same water treatment and groundwater entitlement transfers as described in Clause 5.3.1.

A pipehead on the Harvey Drain and a pipehead on the Brunswick River with conjunctive use of local groundwater would meet Kemerton's demand 92% of the time. The scheme would not be able to supply full demand for an average of 0.8 months every second year.

This scheme would cost in the order of 34 cents per kilolitre.

If the Brunswick pipehead were to be built first, the pipehead on the Harvey Drain would not be required until after five years.

The resulting cost would be in the order of 33 cents per kilolitre. This order of construction would therefore be preferred.

5.3.5 PIPEHEAD ON THE WELLESLEY RIVER AND A PIPEHEAD ON THE BRUNSWICK RIVER WITH CONJUNCTIVE USE OF GROUNDWATER

This option is for initial construction of a pipehead on the Wellesley River coupled with conjunctive use of groundwater. This would be adequate for the first two years. In the third year, a pipehead would need to be constructed on the Brunswick River. This would be used to augment the supply when there is insufficient flow in the Wellesley River.

This option would require the same treatment and groundwater entitlement transfers as described in Clause 5.3.1.

A pipehead on the Wellesley River with a pipehead on the Brunswick River and conjunctive use of groundwater would meet Kemerton's demand 87% of the time. The scheme would not be able to supply full demand for an average of 2.4 months every second year.

This scheme would cost in the order of 30 cents per kilolitre.

If the Brunswick pipehead were to be built first, the backup from the Wellesley River would not be required until after five years.

The resulting cost would be in the order of 31 cents per kilolitre. This order of construction would be preferred.

5.3.6 PIPEHEAD ON THE HARVEY DRAIN AND A PIPEHEAD ON THE WELLESLEY RIVER WITH CONJUNCTIVE USE OF GROUNDWATER

This option is for initial construction of a pipehead on the Harvey Drain and couple it with conjunctive use of groundwater. This would be adequate for the first three years. In the fourth year, a pipehead would need to be constructed on the Wellesley River which would be used to augment the supply when there is insufficient flow in the Harvey Drain.

This option would require the same treatment and groundwater entitlement transfers as described in Clause 5.3.1.

A pipehead on the Harvey Drain with a pipehead on the Wellesley River and conjunctive use of groundwater would meet Kemerton's demand 75% of the time. The scheme would not be able to supply full demand for an average of 3.2 months every year.

This scheme would cost in the order of 33 cents per kilolitre.

If the Harvey Drain pipehead were to be built first, the backup from the Wellesley River would not be required until after five years.

The resulting cost would be in the order of 32 cents per kilolitre. This order of construction would be preferred.

6.0 PREFERRED SOURCE

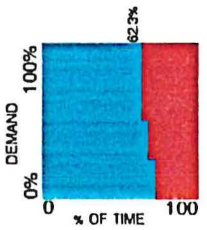
The preferred source is the Wellington Dam which can be implemented immediately. This source gives a secure supply and can be treated to an acceptable quality.

It would be preferred for an untreated supply to be provided with each industry treating its own water in the quantity and to the standard it requires.

TABLE 2
Kemerton Water Supply Schemes
Comparison of Security of Supply

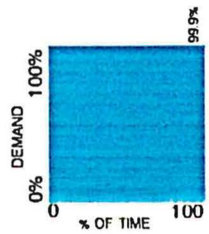
Indicates supply capability

Indicates where demand cannot be supplied



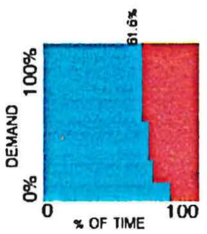
Wellesley River
with local groundwater

cost $0.25/kl
Salinity 750 mg/l



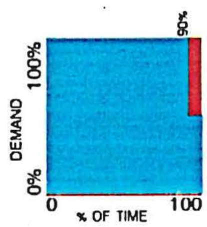
Collie River
(from Wellington Dam)

cost $0.34/kl
salinity 250 mg/l
(combination of brackish and desalinated water)



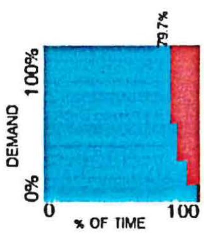
Harvey Diversion Drain
with local groundwater

Cost $0.32/kl
salinity 350 mg\l



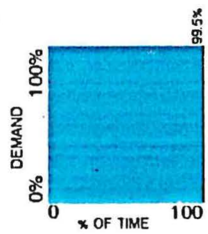
Brunswick Dam
(5 million cu m storage)

cost $0.46/kl
salinity 250 mg/l



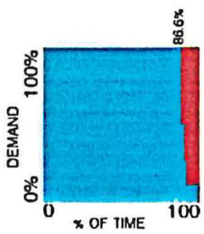
Brunswick River
with local groundwater

cost $0.27/kl
salinity 250mg/l



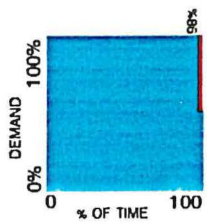
Harvey Dam

cost $0.29/kl
salinity 200mg/l

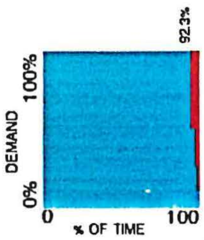


Brunswick River with
Wellesley River
and local groundwater

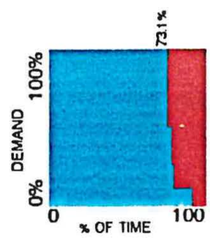
cost $0.30/kl
salinity 300mg/l



Brunswick Dam
(10 million cu m storage)
cost $0.48/kl
salinity 250mg/l



Brunswick River with
Harvey Diversion Drain
and local groundwater
cost $0.33/kl
salinity 300mg/l



Harvey Diversion Drain
Wellesley River
and groundwater
cost $32.0
salinity 450mg/l

TABLE 3 - COMPARISON OF SOURCES

	OPTION		WATER QUALITY mg/l	SECURITY OF SUPPLY	FREQUENCY OF RESTRICTIONS	COST PER KILOLITRE	COMMENTS
1	Inject into groundwater frm Wellesley		750	60.0%	3 months per year	$0.40	
2	Inject into groundwater frm Brunswick		600	80.0%	2 months per year	$0.42	
3	Brunswick Dam		250	90.0%	1 year in 10	$0.46	This option may receive strong opposition (social impacts)
4	Harvey Dam		200	99.5%	1 year in 100	$0.29	This option can only operate if water entitlements in Harvey Dam can be transferred to Kemerton industries
5	Wellington Dam	100% at	250	99.9%	<1 year in 100	$0.64	Wellington Dam water currently fluctuates between 800 mg/l and 1600 mg/l. It is anticipated that these figures will be lower by 2010. This option is for desalinating all water used
		68% at 32% at	1100 250	99.9%	<1 year in 100	$0.34	This option provides for two reticulation systems - one supplying raw water (68% of total volume) for activities such as cooling, wash-down etc, and the other supplying 33% of total volume desalinated water for process uses.
		90% at 10% at	1100 250	99.9%	<1 year in 100	$0.24	This option provides for two reticulation systems - one supplying raw water (90% of total volume) for activities such as cooling, wash-down etc, and the other supplying 10% of total volume
			1100	99.9%	<1 year in 100	$0.17	desalinated water for process uses.
6	Brunswick pipehead with conjunctive use of groundwater		250	79.7%	2.5 months per year	$0.27	This option requires that existing bore licenses be revoked and allowing the groundwater source to be included in the scheme supply
7	Harvey Drain pipehead with conjunctive use of groundwater		350	61.6%	4.6 months per year	$0.32	This option requires that existing bore licenses be resumed and incorporated into the scheme supply
8	Wellesley River pipehead with conjunctive use of groundwater		750	62.3%	4.5 months per year	$0.25	This option requires that existing bore licenses be resumed and incorporated into the scheme supply
9	Brunswick p/h backed up by Harvey Dr with conjunctive use of groundwater		300	92.3%	0.8 months 1 year in 2	$0.33	This option requires that existing bore licenses be resumed and incorporated into the scheme supply
10	Brunswick p/h backed up by Wellesley R with conjunctive use of groundwater		300 1000	86.6%	2.8 months 1 year in 2	$0.31	This option requires that existing bore licenses be resumed and incorporated into the scheme supply
11	Harvey Dr backed up by Brunswick R with conjunctive use of groundwater		300 1000	92.3%	0.8 months 1 year in 2	$0.34	This option requires that existing bore licenses be resumed and incorporated into the scheme supply
12	Harvey Dr backed up by Wellesley R with conjunctive use of groundwater		450 1000	73.1%	3.2 months per year	$0.32	This option requires that existing bore licenses be resumed and incorporated into the scheme supply
13	Wellesley R backed up by Brunswick R with conjunctive use of groundwater		700 1000	86.6%	2.8 months 1 year in 2	$0.30	This option requires that existing bore licenses be resumed and incorporated into the scheme supply
14	Wellesley R backed up by Harvey Dr with conjunctive use of groundwater		700 1000	73.1%	3.2 months per year	$0.33	This option requires that existing bore licenses be resumed and incorporated into the scheme supply

7.0 EFFLUENT DISPOSAL

The Water Authority has extensive experience in the planning, investigation, design, operation and maintenance of ocean outfall systems for treated municipal wastewater. These systems are designed for a specific effluent quality discharging into the marine environment such that established water quality criteria defined by the EPA are maintained, both at initial and design conditions.

The proposal for Kemerton is to install an outfall without reference to the specific quality or quantity of the treated industrial wastewaters to be discharged. Each industry as it is established will then be required to treat its wastewater to suit the outfall provided. This could incur substantial costs to an industry which may be required to spend large amounts of money on effluent treatment to suit the then existing outfall, when a differently designed outfall, (eg. a longer outfall may have solved their problem far more economically).

It should be remembered that each industry has its own wastewater, both quantitatively and qualitatively. Industrial wastewaters were considered when the Authority investigated the Cape Peron Outfall, and industries were specifically excluded from that system because of the large variability of the different industrial wastewaters and their incompatibility with the treated municipal wastewater handled by the Authority.

As the proposed outfall will convey treated industrial wastewater, participating industries themselves are seen as the most appropriate operators of the system, as they are experienced with their wastewater and have control over their treatment processes.

The Authority has no experience in outfalls for treated industrial wastewater and consequently considers that the services of a consultancy experienced in the field of industrial wastewater outfalls should be sought, to provide the necessary expertise for planning, investigation, design and operation of such a system. The Water Authority will be willing to be involved in an advisory capacity, possibly by representation on a steering committee to oversee the project.

The Authority could provide further assistance with the offshore monitoring programme for the outfall once it has become operational. This will be a requirement for EPA approval. The Authority carries out these programmes for all its outfalls both for its own performance measurement requirements, as well as to ensure the environmental conditions are me. The cost for this assistance would have to be met by DRD of the industries concerned.

In order to provide some preliminary guidance on this matter, the Authority offers the following advice:

i) From the Authority's experience it is preferable for each individual industry (or groups of similar industries), to treat, or at least partially treat its wastewater prior to entering a combined system. Overall, this is likely to result in the most cost effective system. The true cost of alternatives, such as combining wastewaters in a central treatment facility, or completely separate treatment and disposal for each individual industry, cannot be realistically assessed without detailed information on the nature of each wastewater stream.

ii) As an indication of costs, a very preliminary estimate has been made for an effluent disposal system based on the following assumptions:

- 40,000 m3/d peak discharge.
- Industry treats to meet EPA water quality criteria.
- Industry delivers treated wastewater to a central reservoir with 24 hours storage.
- Pumping station at storage reservoir pumps 8 kilometres to the coast (through an 800 mm pressure main).
- Only minimal allowance for excavation in rock, dewatering, and restoration for the storage reservoir and the pressure main route.
- 800 mm marine outfall extending 1 kilometre offshore.

The capital cost of such a system would be approximately $14 million. Based on borrowing capital at 14% per annum and replacing capital assets after 25 years, then the cost would be about $3 million per annum including operating and some allowance for environmental monitoring (At full utilisation of 10 million m3 per annum, this would amount to 30 cents/m3 or at 50% utilisation, slightly less than 60 cents/m3).

Factors which may dramatically affect these costs are:

- The extent of rock excavation, dewatering and restoration required to lay the pressure main and excavate the storage reservoir.
- Stabilisation of the sand dunes adjacent to the coastline.
- The extent of environmental monitoring required.
- The extent of burial required to ensure security of the marine outfall in the surf zone.
- Variation of the offshore length of the outfall. (Normally the length of a marine outfall is based on effluent quality and the oceanographic characteristics of the receiving waters.)

The above comments are offered to DRD to give some appreciation of effluent disposal requirements. As stated previously, a competent consultant should be engaged by DRD if a more detailed assessment is required.

8.0 REFERENCES

State Planning Commission (1983) **Bunbury Region Plan - Policy Statement** State Planning Commission, Western Australia.

South West Development Authority (1988) **South West Strategy - Draft Report** South West Development Authority, Western Australia.

Feilman Planning Consultants (1988) **Kemerton Industrial Parklands - Draft Report** Feilman Planning Consultants, Town Planners

Stokes, R.A., Waugh, A.S., Pierce, L.J. (1988) **Brunswick River Yield** Water Authority Report WS 30.

Technical Working Group - Irrigation Strategy Study (1990) **Irrigation Strategy Study South-West Western Australia - Phase 1 Report** Water Authority Report WP 95.

Jacob, Peter (1990) **The Economics of Irrigated Agriculture** Technical Working Group - Irrigation Strategy Study - Water Authority Report WP 96.

Goodall, Peter (1990) **Bunbury Region Water Source Development - Second Draft** Water Authority Report WP 86