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Removal of clay - shale from Eastern Creek waste depot
environment impact statement

L92/0602



WASTE RECYCLING & PROCESSING SERVICE
OF NEW SOUTH WALES



REMOVAL OF CLAY/SHALE FROM EASTERN CREEK WASTE DEPOT

Environmental Impact Statement



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REMOVAL OF CLAY/SHALE FROM EASTERN CREEK WASTE DEPOT

Environmental Impact Statement

For:
Waste Recycling and Processing Service

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Mitchell McCotter & Associates Pty Ltd declares that it does not have a commercial interest in the outcome of this project. Although the firm may be asked to provide further advice related to this EIS and environmental approvals, it will not be taking part in any detailed engineering design or construction work which may be undertaken on the project.

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SUMMARY

Eastern Creek waste depot is a vital component of Sydney's waste management system providing landfill disposal for waste collected from six council areas in western Sydney. The depot has remaining capacity to accept waste at the current rate of input for about five years. The Waste Recycling and Processing Service has taken steps to conserve landfill capacity at Eastern Creek by restricting acceptance of commercial and industrial waste at the depot and setting up recycling facilities which offer free disposal of separated recyclable materials.

The current proposal is another initiative to prolong the life of the depot. It is proposed that additional clay/shale be extracted from within the designated landfill area and removed from the site to recipients in the western Sydney area.

Clay/shale is already extracted and used to cover deposited waste as part of normal daily operations. The proposal would result in deeper excavation with the additional void being filled with waste up to approved final contours.

It is expected that the proposal will add from two to three years additional life to the depot. There will be very little change to site operations, apart from a quicker rate of excavation using equipment already in use at the depot. Clay/shale will be removed by truck up to a maximum of 96 loads per day. The additional traffic will partly compensate for the fall off in vehicle numbers which has occurred since the introduction of restrictions on commercial and industrial waste in January 1992.

Potential recipients for excavated material include five brickworks and a private landfill depot which may use clay/shale for covering waste. Acceptance of clay/shale at any of these sites would be subject to commercial negotiations. Other possible recipients may emerge from time to time.

Apart from extending the life of the waste depot the proposal will not significantly alter its environmental impacts. No additional area of land will be excavated or affected by depot operations. Environmental safeguards will continue to be implemented and upgraded to control water quality in surface and ground water, dust, noise, landfill gas and odour, vermin, safety, litter, appearance, traffic, flora and fauna, archaeology and flooding.

A hydrogeological investigation has been undertaken, concluding that underlying rock has a low to very low transmissivity for groundwater and that there is no indication of leachate entering the groundwater system.

A traffic study has indicated that the surrounding road system is capable of accepting the additional clay/shale haulage vehicles. Depending on the destination of excavated material

and the number of trucks in use on the haulage circuit, transport of clay/shale may be noticeable on major roads more distant from the depot. Even after allowing for clay/shale haulage at the maximum rate of 96 truck loads per day, Eastern Creek depot will still attract fewer trucks than during 1991, prior to restrictions on commercial and industrial waste.

The alternative of not proceeding with the proposal or removing clay/shale at a lesser rate would lose part or all of the opportunity to bury additional waste at Eastern Creek. Apart from Grange Avenue depot, which will close later this year, there are no other waste depots in Western Sydney registered to accept putrescible waste.

If the life of Eastern Creek depot is not extended as proposed, the advantage of additional time to develop a successor for the depot will be lost. As a consequence it is likely that Councils in western Sydney will suffer higher costs for waste disposal at an earlier time than might otherwise have been necessary.

1. INTRODUCTION

INTRODUCTION

1.1 BACKGROUND

The Waste Recycling and Processing Service (Waste Service) and its predecessors have operated a regional waste depot in Wallgrove Road, Eastern Creek since July 1984. Figure 1.1 shows the location of the site. The depot has accepted waste from councils, businesses and residents of western Sydney and has now reached approximately half of its final capacity.

During 1991 the depot disposed of some 413,000 tonnes of waste, an average of about 8,000 tonnes per week. Most commercial and industrial waste has been excluded from the depot since early 1992. This restriction was applied to extend the life of Eastern Creek depot and to encourage development of alternative disposal sites by the private sector. The result has been to reduce waste input during 1992 to some 307,000 tonnes, an average of about 6000 tonnes per week. Further tightening of restrictions at Eastern Creek for commercial waste will occur later this year with the opening of Seven Hills Transfer Station.

Eastern Creek depot received development approval in two stages. The initial development consent granted in May, 1982 referred to the northern portion of the site, owned by the Department of Planning. The original consent approved placement of 1.6 million tonnes of waste on the Department's 73 hectare property.

A subsequent development consent granted in February, 1990 approved overtopping the existing landfill and extending the depot onto an adjoining 41 hectare parcel of land to the south, acquired for this purpose by the then Metropolitan Waste Disposal Authority. Expansion of the depot yielded a further 1.9 million cubic metres of landfill space giving a total depot capacity of 3.5 million cubic metres.

At the current stage of operations, the three landfill mounds wholly within the original depot site have been filled to capacity including the overtopping and recontouring approved in 1990. Landfilling has commenced for the fourth mound, which is predominantly within the extension area. Working areas have been established at the northern and southern ends of this final part of the landfill.

It is estimated that at the beginning of 1993 the capacity remaining in the depot below final contours approved in 1990 was sufficient for disposal of 1.5 million tonnes of waste. At current rates of waste input, this capacity could be exhausted in approximately five years.

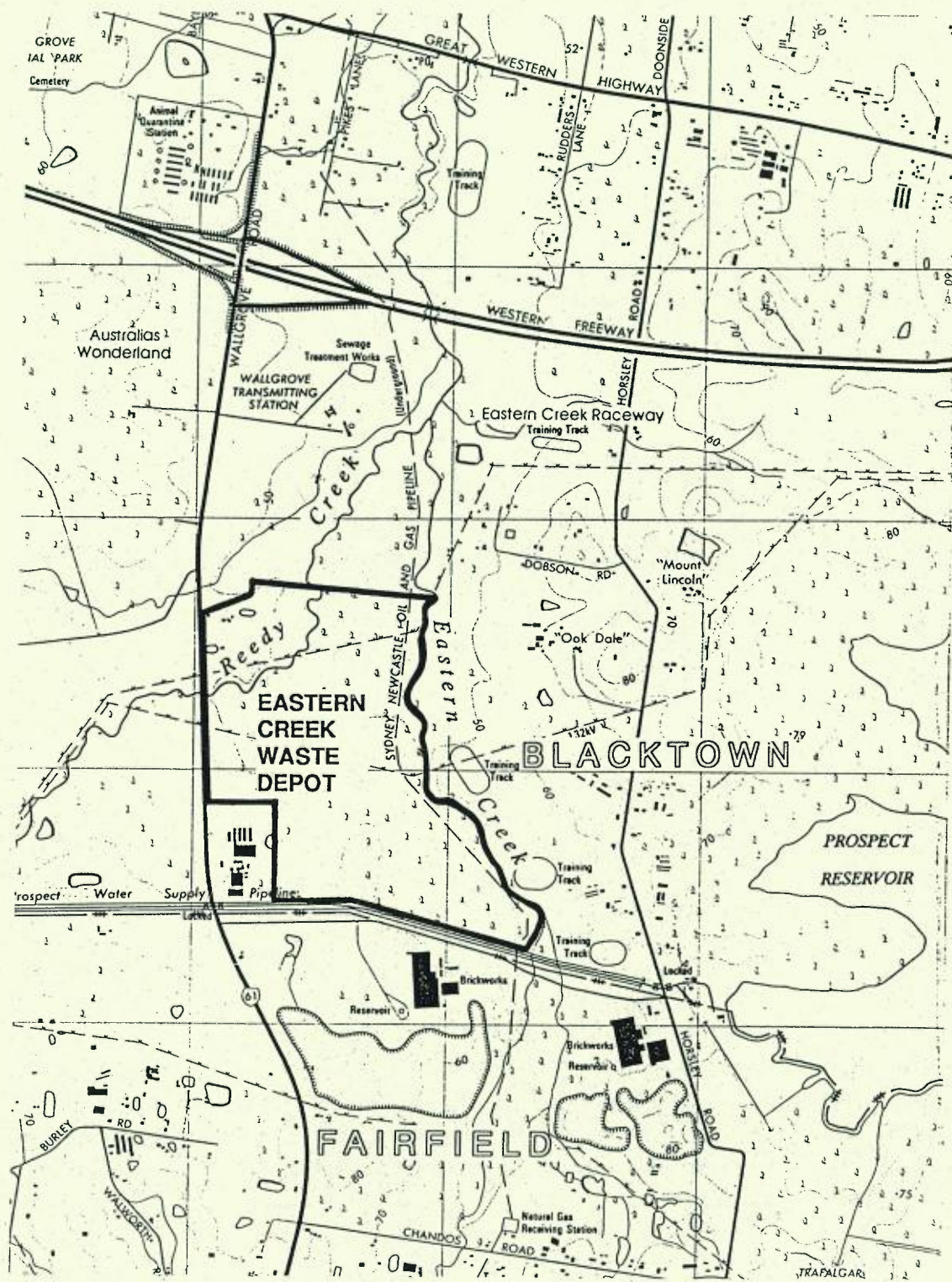


Figure 1.1 LOCALITY PLAN

The actual life of the depot is subject to changes in its catchment, types of waste accepted and waste generation rates in the community.

The proposal aims to increase available airspace for waste disposal at Eastern Creek depot by excavating and removing clay/shale from the landfill area prior to placing waste. Excavation of clay/shale will occur in any event as part of normal depot operations. Excavated material is used for covering waste, but because it is returned to the landfill, the excavation does not provide any net increase in landfill capacity. To gain additional capacity, it is necessary to remove excavated material from the site as now proposed.

1.2 PURPOSE OF THIS DOCUMENT

This environmental impact statement has been prepared because the extraction and removal of clay/shale satisfies the definition of extractive industry and is hence a designated development under the Environmental Planning and Assessment Act.

The current document seeks development approval for the depot incorporating removal of extracted clay/shale from the site.

The objectives of the proposal are to:

- ☐ extract additional clay/shale and remove it from the site; and
- ☐ continue to operate the facility as a solid waste disposal depot filling the void created by removal of clay/shale up to approved final contours.

1.3 THE PROPONENT

The proponent of the development is the Waste Recycling and Processing Service of New South Wales (Waste Service). The Waste Service will receive the determination of the development application and if the proposal is approved, be responsible for meeting any conditions attached to the approval.

The Waste Service currently operates five solid waste landfill depots and four transfer stations. Together with a council-run incinerator at Waterloo, these facilities receive virtually all of the putrescible waste generated within metropolitan Sydney, serving 40 of the 41 councils within the region. The Waste Service promotes recycling and provides recycling facilities at all of its depots.

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Solid waste landfill depots operated by the Waste Service are:

- ☐ Bare Creek (Belrose);
- ☐ Eastern Creek;
- ☐ Grange Avenue (Marsden Park);
- ☐ Jacks Gully (Camden); and
- ☐ Lucas Heights.

Transfer stations are at Artarmon, Auburn, Rockdale and Ryde.

Figure 1.2 shows the location of Waste Service depots and transfer stations in the metropolitan area. Grange Avenue and Bare Creek depots are scheduled to close in the near future to be replaced by transfer stations at Seven Hills and Belrose.

Licencing of waste disposal facilities is the responsibility of the Environment Protection Authority, which also has overall responsibility for promotion of recycling, waste minimisation and other strategic planning initiatives for Sydney's solid waste stream.

1.4 DECISION-MAKING PROCESS

A development application seeking approval for the proposal will be submitted to the Department of Planning. The proposal is designated development because it is classified an extractive industry. Extraction of clay/shale continuously occurs in the depot as part of normal operations in addition to the quantities planned to be extracted for removal from site. Extraction for either purpose is designated development.

Under the Environmental Planning and Assessment Act, 1979 applications for approval of designated development are required to be accompanied by an environmental impact statement (EIS) prepared in accordance with the Environmental Planning and Assessment Regulation, 1980.

This document has been so prepared. Director's requirements regarding the form and content of the EIS have been obtained from the Department of Planning and are included as an appendix. A certificate as required by the Regulation is also contained in an appendix. This EIS has been prepared having regard to the Director's requirements and matters listed for consideration in Clause 34 of the Regulation.

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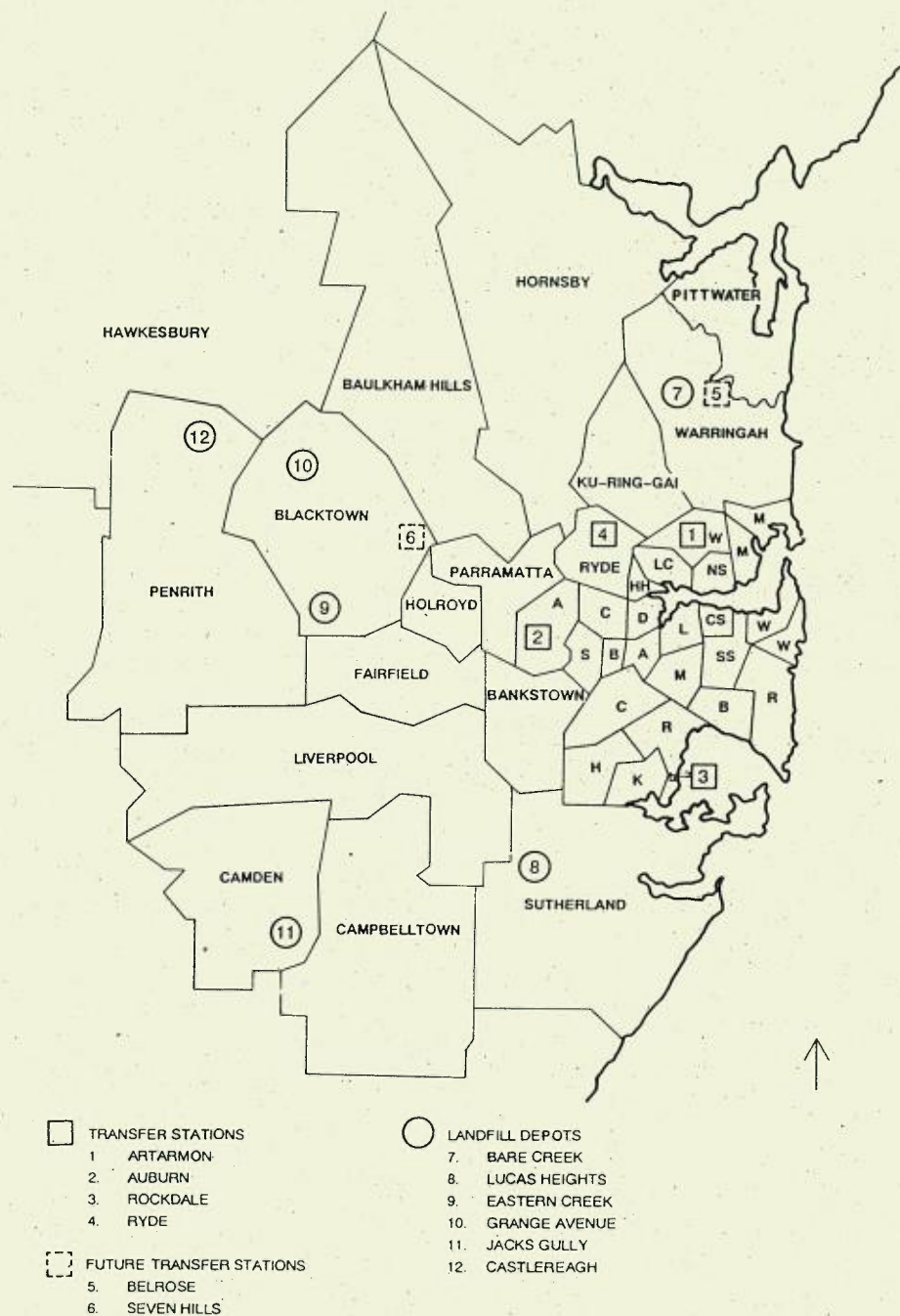


Figure 1.2 WASTE DEPOTS AND TRANSFER STATIONS OPERATED BY THE WASTE SERVICE

Under the terms of State Environmental Planning Policy (SEPP) No. 29 – Western Sydney Recreation Area, the Minister for Planning is the consent authority. The Department of Planning will have responsibility for exhibiting the environmental impact statement and receiving submissions from the public prior to submitting the matter to the Minister for determination. The Department may seek assistance from Blacktown Council to undertake the public exhibition.

Part of the site is within 500 metres of land described in Schedule 1 of Sydney Regional Environmental Plan (SREP) No. 9 – (Extractive Industry) as being a clay/shale extraction area of regional significance. Normally the concurrence of the Department of Mineral Resources and Environment Protection Authority would be required to carry out development within this part of the site. Such concurrence would be routinely forthcoming for this proposal, but is not now required, as the relevant provision of SREP No. 9 has been overridden by SEPP No. 29.

1.5 CONSULTATION

In the course of preparing this environmental impact statement, nine public authorities were contacted by correspondence seeking comments on the proposal. Follow-up contact was arranged where this was necessary to further discuss matters of importance.

Owners of properties near the southern part of the site, (where the additional extraction will take place) were also approached to advise them of the proposal and discuss any issues or concerns they wished to raise. Potential recipients of excavated clay/shale from the site were contacted to confirm their interest in receiving this material.

Authorities contacted include:

- ☐ Blacktown City Council;
- ☐ Fairfield City Council;
- ☐ Environment Protection Authority;
- ☐ Department of Health;
- ☐ Department of Conservation and Land Management;
- ☐ Water Board;

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- ☐ Department of Water Resources;
- ☐ Roads and Traffic Authority;
- ☐ Department of Mineral Resources.

Responses from public authorities are summarised in an appendix.

Neighbouring property owners contacted include:

- ☐ Water Board;
- ☐ Austral Bricks;
- ☐ Mr D. Damjanovic; and
- ☐ Department of Planning.

Potential recipients of clay/shale who were approached were:

- ☐ Austral Bricks;
- ☐ PGH;
- ☐ Boral; and
- ☐ CSR/Readymix.

2. EASTERN CREEK WASTE DEPOT

EASTERN CREEK WASTE DEPOT

2.1 PROPERTY DESCRIPTION

Eastern Creek depot commenced operation in July 1984 on a 73 hectare site described as Lot Y, DP376524 Wallgrove Road, Eastern Creek and owned by the Department of Planning. In February 1990 approval was granted to expand the depot onto an adjoining 41 hectare parcel of land described as Lot 1, DP778564 and owned by the Waste Service.

As shown in Figure 2.1 the consolidated site has a frontage to Wallgrove Road and adjoins land owned by:

- ☐ Water Board;
- ☐ Mr D. Damjanovic (Poultry Farm);
- ☐ Department of Planning;
- ☐ Royal Australian Air Force.

The site is traversed by buried pipelines for water supply, natural gas and oil. These pipelines are located within easements shown on Figure 2.1. In addition there are two easements for overhead electricity transmission lines.

2.2 THE ROLE OF EASTERN CREEK

2.2.1 *Present Arrangements*

Waste disposal arrangements in western Sydney are in a state of change. At the present time there are two regional waste depots in the area able to receive and dispose of putrescible solid waste: Eastern Creek depot and Grange Avenue depot (at Marsden Park). Both of these facilities are operated by the Waste Service. A number of privately operated depots also exist in the area, but these are approved for disposal of certain types of waste only, usually non-putrescible and demolition waste.

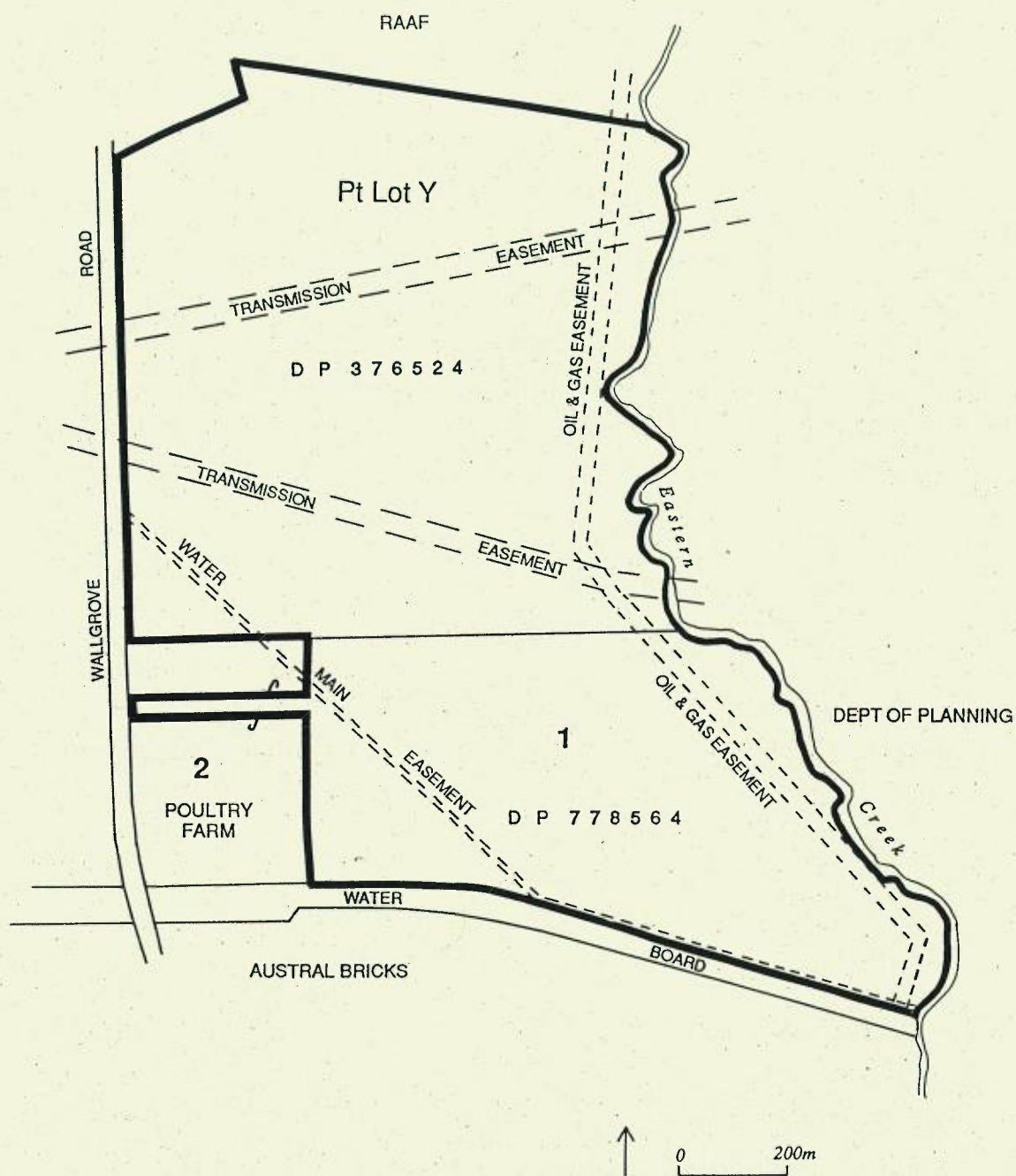


Figure 2.1 THE PROPERTY

During 1991, Eastern Creek depot accepted approximately 413,000 tonnes of waste. Approximately half of this total was commercial or industrial waste brought to the depot in private trucks. The remainder was waste collected by or on behalf of Councils or household waste brought to the depot in small vehicles.

From early 1992 the Waste Service moved to exclude commercial and industrial waste from Eastern Creek and Grange Avenue depots to preserve landfill space for community waste (Council-collected garbage and small vehicle waste). This restriction has initiated a redirection of the pattern of waste transport and disposal in the region. Owing to the absence of alternative putrescible waste disposal opportunities in western Sydney, a period of grace has been allowed during which time commercial putrescible waste is being accepted at Eastern Creek. The period of grace will end when Seven Hills Transfer Station commences operation in mid 1993. The quantity of commercial and industrial waste accepted in 1992 was approximately 75,000 tonnes, down from about 210,000 tonnes the previous year.

Commercial and industrial waste which is made up entirely of separated materials which are recycled or processed at the depot, will continue to be accepted.

During 1992, collected waste primarily from six Council areas was taken to Eastern Creek depot:

- ☐ Penrith;
- ☐ Liverpool;
- ☐ Fairfield;
- ☐ Holroyd;
- ☐ Blacktown (part); and
- ☐ Parramatta (part).

After Grange Avenue depot closes in the near future, Eastern Creek will be the only putrescible waste landfill assured to be operating in the western Sydney area. Consequently, Eastern Creek is of vital importance to the systematic collection and disposal of waste in the Sydney area. The depot provides a cost-effective service for councils in western Sydney.

2.2.2 *Foreseeable Changes*

Over the next twelve months a number of changes are either planned or expected to occur in the waste disposal system for western Sydney:

- ☐ Grange Avenue depot will close;
- ☐ Seven Hills transfer station will open;
- ☐ Castlereagh secure landfill will commence operation as a solid waste depot; and
- ☐ approval may be granted to private depot operators to dispose of putrescible waste.

Grange Avenue/Seven Hills

Grange Avenue depot is almost filled to capacity and is scheduled to close in the near future. To provide a replacement service in the Blacktown area, Seven Hills transfer station has been constructed in Powers Road. When Grange Avenue depot closes it is expected most of the Council-collected waste previously taken to this depot will be taken to the new transfer station although an additional portion of Blacktown's waste may be redirected to Eastern Creek.

Castlereagh

Castlereagh depot has accepted limited quantities of solid waste since 1974, as required for use as an absorbing medium in the liquid waste disposal cells. Liquid waste disposal at the depot has declined markedly in the last few years as generators have been encouraged to use the Aqueous Waste Plant at Lidcombe or convert their waste into a form suitable for landfill disposal. The requirement for solid waste as an absorbing medium at Castlereagh has declined accordingly.

It is planned to overtop the Castlereagh secure landfill with solid waste. The Waste Service already holds conditional approval for this activity, but is awaiting the outcome of a Stage II environmental audit of the site before proceeding. An extensive testing and monitoring programme for a trial section of overtopping has been undertaken at Castlereagh depot, confirming that overtopping would be acceptable. When the depot commences solid waste overtopping, transfer vehicles from future transfer stations at Seven Hills and Belrose will haul waste to Castlereagh. Small vehicles are not expected to be admitted to Castlereagh depot, but council garbage trucks may be accepted.

Private Depots

At this point in time, no private organisation holds a licence to dispose of putrescible waste. Before making application to the Environment Protection Authority for such a licence it will be necessary for the applicant to obtain development consent from the relevant council.

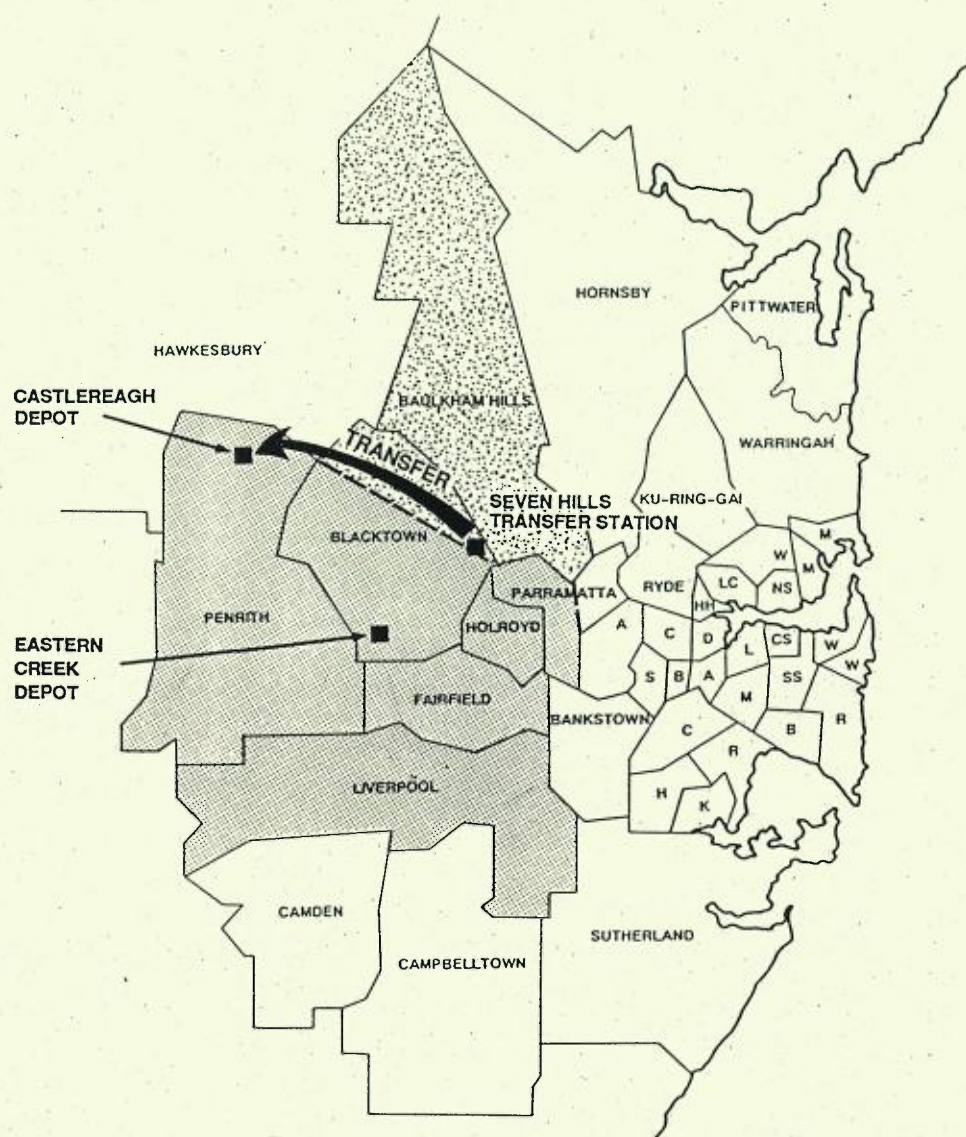
During 1992 a private organisation received development consent for a major non-putrescible waste depot a few kilometres west of Eastern Creek. In addition, Penrith Council has been informed by a private operator that a development application will be lodged seeking approval for an existing non-putrescible waste depot to the south of Penrith to accept putrescible waste. Exclusion of commercial and industrial waste from Eastern Creek and Grange Avenue depots has increased waste input to existing private depots in western Sydney and has no doubt given greater impetus to development of new disposal facilities.

After closure of Grange Avenue depot it is anticipated that the pattern for disposal of Council-collected waste for the western Sydney region will be as shown in Figure 2.2. As can be seen from the figure, Eastern Creek will continue to play a vital role for waste disposal in western Sydney.

2.3 TYPES OF WASTE

Eastern Creek depot accepts only solid waste which is approved as suitable for landfill disposal by the Environment Protection Authority (EPA). Waste which is excluded from landfills by the EPA is listed in an appendix. Commercial and industrial waste (except for recyclable or processable commercial waste), has been restricted at the depot since the beginning of 1992 and will not be accepted after mid 1993. Waste types which will continue to be accepted at the depot fall within five categories:

- ☐ domestic garbage;
- ☐ council clean-up;
- ☐ municipal refuse;
- ☐ commercial waste which is fully recyclable or processable at the depot;
- ☐ waste transported by residents in small vehicles.



ANTICIPATED ARRANGEMENT AFTER CLOSURE OF GRANGE AVENUE DEPOT

- WASTE CATCHMENT
- EASTERN CREEK DEPOT
 - SEVEN HILLS TRANSFER STATION

Figure 2.2 DISPOSAL OF COUNCIL-COLLECTED WASTE IN WESTERN SYDNEY

Domestic garbage is the contents of householders' garbage cans, normally collected in a compacting garbage truck. Domestic waste was sampled in three local government areas during 1986 to analyse its composition, as shown in Table 2.1. A further analysis of domestic garbage will take place this year.

Table 2.1 **COMPOSITION OF DOMESTIC GARBAGE**

Component	Percentage
Food Waste	27%
Paper and Cardboard	21%
Garden Waste	21%
Glass	9%
Plastic	8%
Metal (mostly ferrous)	6%
Wood, Textiles, Rubber	4%
Ceramics, dirt, rock	4%
TOTAL	100%

Council clean-up waste is material collected from kerbsides in residential areas as part of an organised campaign, often on a biannual basis. Municipal refuse is street sweepings, beach and park waste, litter bin waste and council engineers' waste.

Processable commercial waste refers to items from business undertakings which are tipped separately in a waste recycling or processing area and may include:

- ☐ wood – flattened crates, pallets, tree loppings, dressed or sawn timber;
- ☐ building and demolition – tiles, bricks, concrete, asphalt;
- ☐ metals – white goods and steel, aluminium, copper and brass;
- ☐ cans – steel, aluminium;
- ☐ glass – bottles and jars (colour sorted);
- ☐ paper and cardboard; and
- ☐ plastics – PET, HDPE, PVC.

Other than crates, pallets and tree loppings, these items are accepted free of charge at the depot.

Small vehicle waste is usually household waste transported by residents and includes larger items or quantities of material too voluminous to fit in regular household garbage containers. Garden clippings form a significant proportion of this waste. The majority of vehicles visiting the depot on weekends are small vehicles and include sedans, station sedans, utilities, panel vans, box trailers and similar vehicles.

There are certain types of solid waste which, while quite acceptable for disposal at most landfills, present handling difficulties for depot staff. These items are classified by the Waste Service as special waste. Typical waste in this category includes animal carcasses, carbon black, food sludges and asbestos. Special conditions apply for the disposal of asbestos waste providing for segregation, additional depth of burial, wetting, special handling, recording and other relevant matters.

Table 2.2 shows the quantities of various waste types received at Eastern Creek depot during 1991 and 1992.

Table 2.2 **EASTERN CREEK WASTE TYPE ANALYSIS**
tonnes

Waste Type	1991	1992
Council-collected	153,465	184,979
Council clean-up	753	1,301
Municipal refuse	17,633	16,900
Small vehicles	13,658	15,702
Commercial/industrial	209,653	75,746
Demolition	2,729	NIL
Special waste & tyres	15,565	12,755
TOTAL	413,366	307,383

Certain types of waste are excluded from all landfill depots, mainly falling in the categories of liquid, toxic, hazardous or intractable waste. These materials are not approved by the Environment Protection Authority for landfill disposal and are listed in an appendix.

Radioactive waste and hospital and medical waste are excluded from the depot. These wastes are required to be collected from their source by licensed transporters, who as a condition of

their licence are required to take these materials to disposal facilities licensed to receive such waste.

The Waste Service has facilities at its landfill depots and transfer stations to receive household quantities of wastes which are excluded from landfills. They are disposed of separately from the rest of the waste stream. The Waste Service, in conjunction with the Environment Protection Authority and Water Board conducts public campaigns to collect unused pesticides and chemicals from householders to ensure these materials are disposed of properly. Small quantities of excluded waste will nevertheless find their way into landfills. For example, householders may occasionally add a partly-full can of paint or paint thinners to their household garbage. A partly full bottle of household pesticide could also be present on rare occasions. Such small quantities of these materials do not present a problem in a landfill.

Controls to prevent excluded materials entering landfill depots are primarily exercised through the system of licensing waste producers and waste collectors. Companies producing hazardous wastes are required to account for the disposal of this material. Operators who collect and transport such waste are also held accountable. A system of receipt and delivery dockets, checked at each end of the disposal chain allows quantities dispatched and received to be reconciled.

Secondary checks are applied at the waste depot. Weighbridge staff will refuse to admit vehicles with obvious loads of material not accepted at the depot. At the tipping face, depot staff supervise tipping and have the discretion to require the deliverer to remove from the landfill any unacceptable wastes.

Decomposition

Putrescible waste decomposes in a landfill initially under aerobic conditions. When available oxygen has been consumed, anaerobic decomposition commences as a two stage process. In the first stage organic materials, being essentially proteins, carbohydrates, fats and cellulose, are reduced to simple organic materials and carbon dioxide. In the second stage this intermediate product is further reduced to methane and carbon dioxide. The result of putrescible waste decomposition is a compost-like material and landfill gas. Any parasites, pathogens or other organisms arriving in the waste are decomposed in the same manner.

Recycling Potential

The Waste Service has estimated that there is potential to recover approximately 45% of the domestic waste stream for recycling, as shown in Table 2.3.

Table 2.3 RECYCLING POTENTIAL OF DOMESTIC WASTE

Waste Component	Proportion Recoverable
Paper and Cardboard	64%
Food and Garden Waste	41%
Glass	88%
Metal	52%
Plastic	4%
Wood, Textiles, Rubber	—
Ceramics, Dirt, Rock	—
Total	45%

The recently exhibited Waste Management Green Paper (Minister for the Environment 1992) which was prepared to initiate community discussion, states that the New South Wales Government has accepted the objective of achieving a 50% reduction in waste going to landfill per capita by the year 2000 based on 1990 levels. For domestic waste, the Environment Protection Authority has set a goal of 25% reduction by waste minimisation including recycling and a further 25% reduction by materials recovery programmes, including composting. By 1995, a recycling level of 250,000 tonnes of domestic waste will be required, compared with the current 100,000 tonnes. The Environment Protection Authority is developing strategies to achieve the desired goals.

Alternative means of waste disposal to landfilling have been implemented in some parts of the world, particularly where there is a shortage of land suitable for landfilling. There is no suitable alternative disposal method currently available in the western Sydney region. A waste incinerator operates in the eastern suburbs of Sydney but does not offer alternative disposal for western Sydney's waste.

2.4 SOURCE AND DELIVERY

As indicated in Section 2.2, waste from six council areas is normally disposed of in Eastern Creek depot. The quantity of waste from each Council area deposited in 1991 and 1992 is given in Table 2.4.

Table 2.4 DISPOSAL OF COUNCIL WASTE AT EASTERN CREEK (tonnes)

Council	1991 Quantity	1992 Quantity
Penrith	26,961	42,554
Liverpool	20,661	22,033
Fairfield	58,501	56,337
Holroyd	27,528	27,921
Blacktown	14,539	15,538
Parramatta	19,698	22,187
Others	3,967	3,998

Notes: 1. Some waste from Blacktown, Parramatta and Penrith councils was taken to other disposal facilities.
2. "Others" include Leichhardt, Drummoyne and Auburn.

When Grange Avenue depot closes in the near future, it is expected that most of Blacktown Council's collected waste will be redirected to Eastern Creek. A further 50,000 tonnes of waste per annum would be received at Eastern Creek from this source. Closure of Grange Avenue may also marginally increase small vehicle waste at Eastern Creek.

Waste input to the depot varies according to the day of the week and the week of the year. Table 2.5 shows average quantities of waste brought to Eastern Creek on each day of the week in 1992.

Table 2.5 TYPICAL WEEKLY WASTE INPUT TO EASTERN CREEK (1992)
tonnes

Type	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Total
Council waste	881	793	1000	803	822	21	21	4341
Small vehicle waste	29	30	25	26	35	94	106	345
Commercial/industrial	273	236	229	233	288	104	40	1343
Special waste	17	16	35	23	44	-	-	135
TOTAL	1200	1075	1289	1085	1129	219	167	6164

Figure 2.3 plots weekly waste volumes arriving at Eastern Creek for 1991 and 1992, showing the extent of variations experienced at the depot.

Variations occur due to weather and seasonal factors, with the greatest quantity of waste being generated in late spring and early summer. Waste quantities are reduced in the colder months. This may be partly explained by reduced growth of vegetation in winter and the

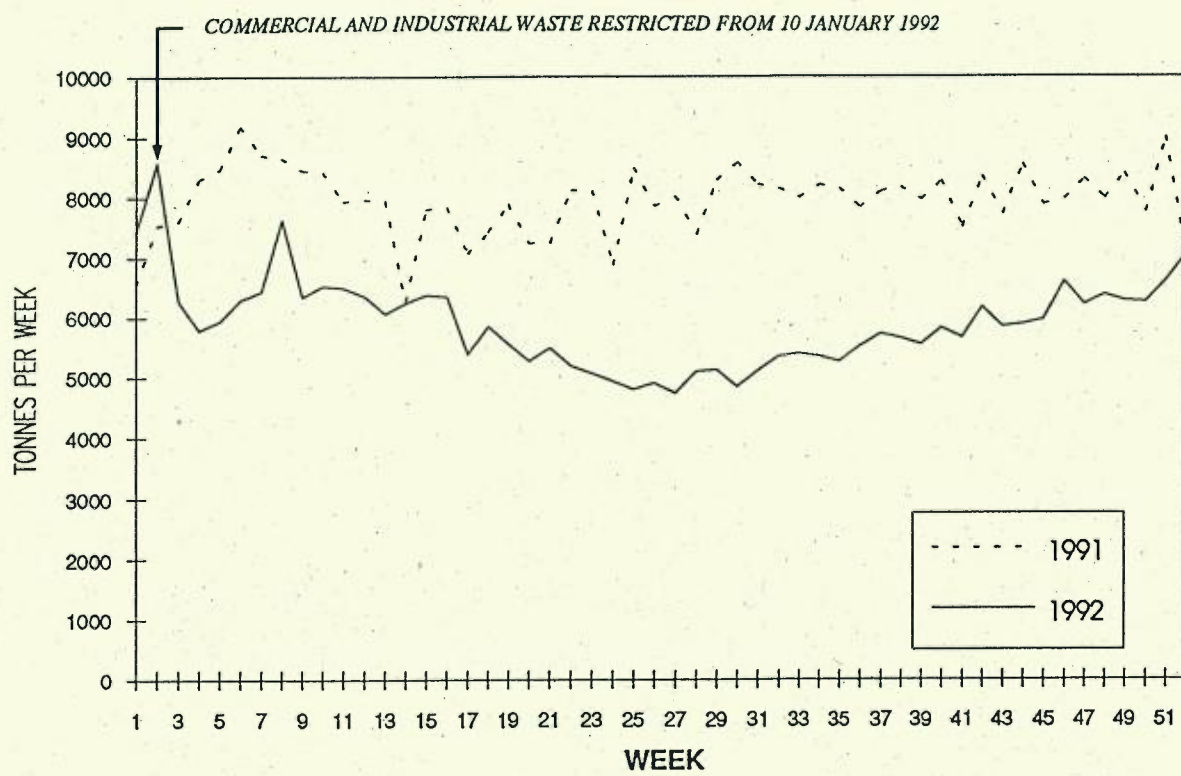


Figure 2.3 WEEKLY WASTE INPUT 1991/1992

shorter daylight hours providing less opportunity for home gardeners. The maximum weekly inputs normally occur during the lead up to Christmas. During 1992 however the maximum week occurred in early January, immediately prior to restrictions being imposed on commercial and industrial waste.

Vehicle numbers visiting the depot show a differing pattern to waste quantities. Small vehicles make up just over half the vehicles for an average weekly period, although on weekends they can account for up to 95% of vehicles. Despite their numbers, small vehicles deposit only about 5% of the total waste input to the depot each week.

Over the eight months to February 1993, 94204 vehicles visited the depot, including 54804 small vehicles and 39400 heavy vehicles. An average of 217 small vehicles and 162 trucks visited the depot each day. On average, 42 of those trucks were carrying commercial putrescible waste and will not be admitted to the depot after mid-1993 when Seven Hills Transfer Station opens. Allowing for increased waste input from Blacktown Council, average truck numbers are expected to fall to approximately 145 per day after mid - 1993.

For the months of January, April and October 1992, table 2.6 shows vehicle numbers bringing waste to Eastern Creek depot each weekday during an average week. This table highlights the wide variability in traffic volumes associated with the depot.

Table 2.6 VEHICLE NUMBERS AT EASTERN CREEK DEPOT (1992)

Vehicle Type		Mon	Tues	Wed	Thur	Fri	Sat	Sun	Total
Council Trucks	Jan*	121	113	70	115	97	42	1	559
	April	134	113	145	118	120	1	4	635
	Oct	126	127	156	132	118	5	3	666
Small Vehicles	Jan*	533	202	121	459	550	597	552	3014
	April	152	60	124	124	214	236	550	1461
	Oct	165	163	136	132	152	242	357	1447
Other Trucks	Jan*	204	168	36	202	210	168	149	1142
	April	73	65	74	62	76	29	19	398
	Oct	78	82	82	78	87	65	46	518
TOTAL	Jan*	863	483	227	776	857	807	702	4715
	April	359	238	343	304	410	267	573	2494
	Oct	370	372	373	343	357	410	406	2631

* January figures are prior to restriction of commercial/industrial waste

Time of arrival of vehicles at the waste depot is given in Table 2.7, averaged for weekdays during the month of October, 1992.

Table 2.7 WEEKDAY ARRIVAL TIMES AT EASTERN CREEK, OCTOBER 1992

Hour	No. of Trucks	No. of Small Vehicles
04:00 – 05:00	1	–
05:00 – 06:00	16	–
06:00 – 07:00	25	1
07:00 – 08:00	27	4
08:00 – 09:00	24	8
09:00 – 10:00	27	17
10:00 – 11:00	22	20
11:00 – 12:00	18	23
12:00 – 13:00	14	21
13:00 – 14:00	17	20
14:00 – 15:00	15	18
15:00 – 16:00	6	16

Depot Life

From volumetric survey it has been estimated that at the beginning of 1993 Eastern Creek depot had remaining capacity for approximately 1.5 million tonnes of waste. A current rates of waste input the depot can continue operating for approximately five years. Its actual life however, is subject to changes in the waste catchment, types of waste accepted and waste generation rates in the community.

In mid 1993 tightened restrictions on commercial and industrial waste acceptance at Eastern Creek will reduce waste input to the depot by about 75000 tonnes per annum. At the same time closure of Grange Avenue waste depot is expected to result in redirection of approximately 50,000 tonnes per annum of Blacktown City's waste to Eastern Creek depot. Consequently there is expected to be a small net reduction in waste input which may extend the life of Eastern Creek by a few months.

2.5 SITE LAYOUT

Figure 2.4 shows the site layout of Eastern Creek depot. There are four landfill areas on the property arranged to fit between various easements and the course of Reedy Creek. At the present time landfill areas 1, 2 and 3 are complete and undergoing rehabilitation.

Waste disposal operations are taking place in the largest landfill, Area 4, where work commenced at the northern end approximately two years ago. Excavation of the southern part of Area 4 commenced during 1992. Area 4 is the source of the proposed clay/shale extraction for removal from site, the subject of this environmental impact statement.

The waste depot is surrounded by a man-proof chain wire fence and has a single point of access to Wallgrove Road. Buildings and facilities have been established in a central location near the entrance roadway. The largest building on site is the recycling centre which commenced operation during 1992.

Figure 2.5 shows the detail of access road, fencing, earth bunds and tree planting established in conjunction with the landfill in Area 4. The figure also shows the approved final contours for landfilling.

2.6 DEPOT OPERATIONS

The method of operating the depot was described in the Review of Environmental Factors report submitted with the development application for the depot extension in 1989 (Mitchell McCotter 1989). Major features of depot operation are outlined below.

2.6.1 *Control and Direction*

Eastern Creek depot is open to the public from 7.00 am to 4.00 pm on weekdays and from 8.00 am to 5.00 pm on weekends. Council garbage trucks are admitted to the depot prior to public opening times to allow normal waste collections to proceed in the early morning hours. The depot is closed to the public on Good Friday and Christmas Day, although Council garbage trucks are admitted on these days to suit collection rosters.

Waste vehicles enter the depot by passing through the entrance station. Trucks and heavily laden trailers or utilities are weighed to allow calculation of tipping fees. Charges for 1992 and 1993 at Eastern Creek depot are given in Table 2.8.

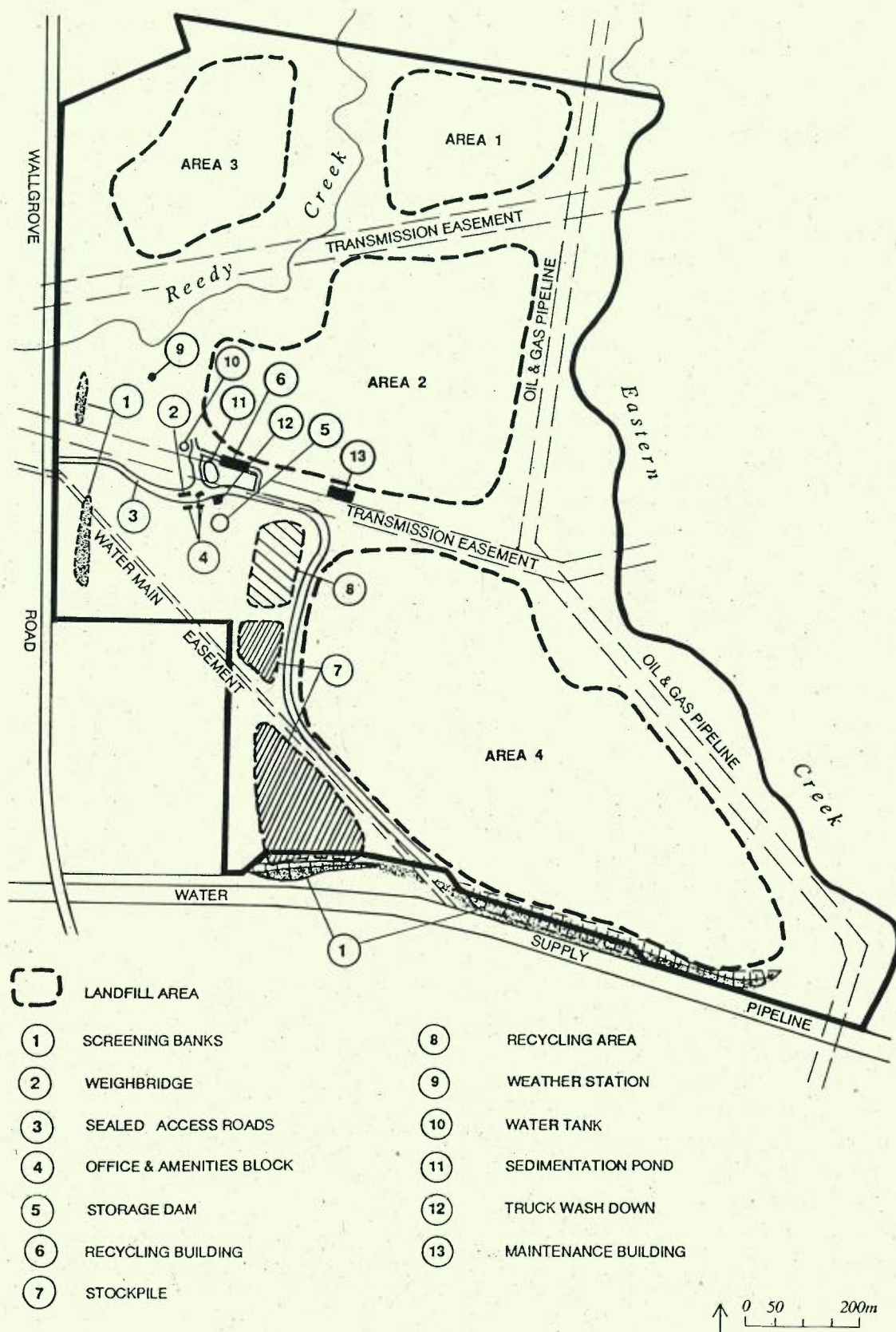


Figure 2.4 SITE LAYOUT

Figure 2.5 DETAIL OF LANDFILL AREA 4

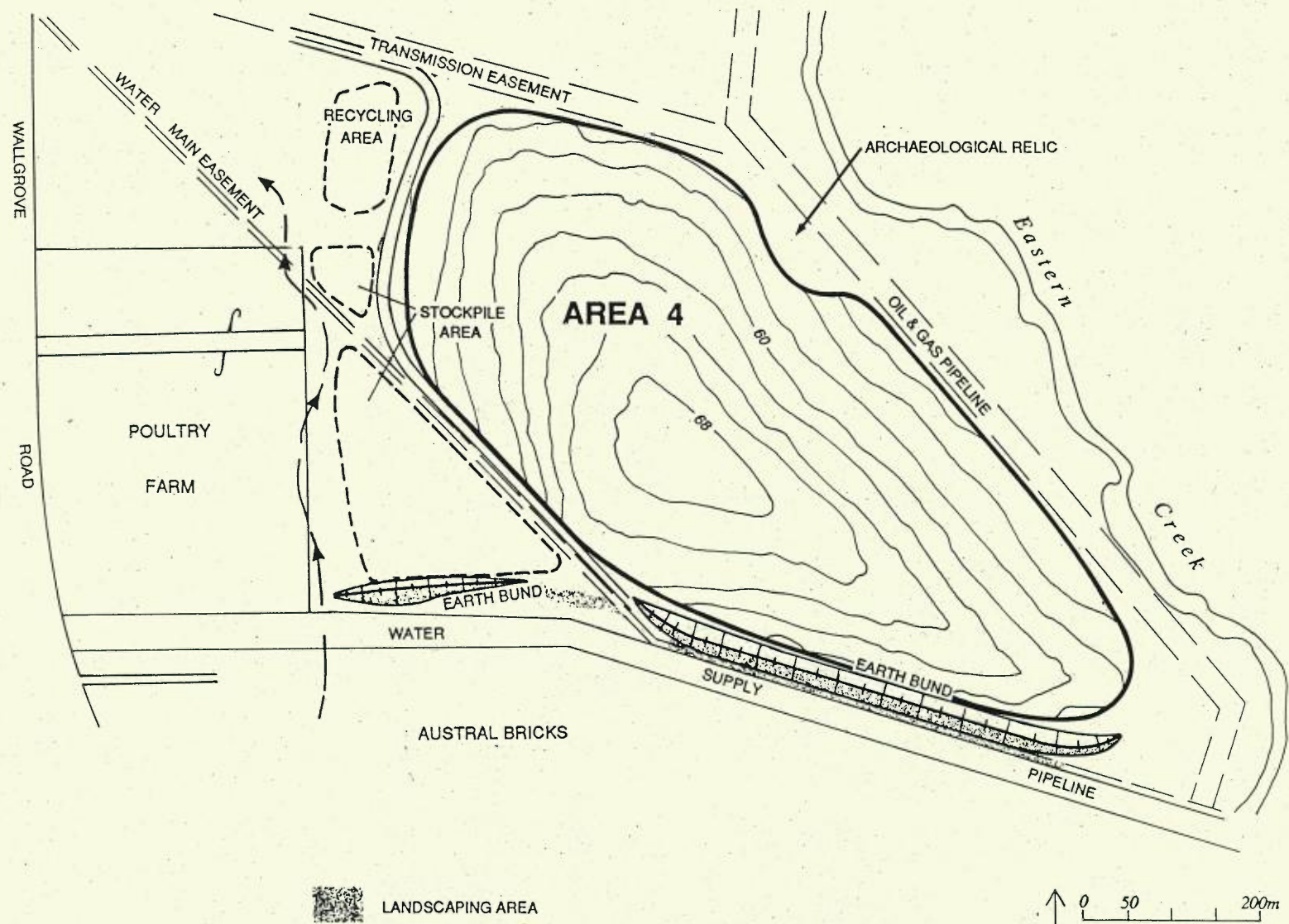


Table 2.8 TIPPING CHARGES AT EASTERN CREEK DEPOT

Type	1992 Charge	1993 Charge
Council Waste	\$15.94 per tonne	\$18.90 per tonne
sedans and station sedans (load under 0.3 tonne)	\$1.90 per vehicle	\$2.00 per vehicle
utilities, vans and trailers (load under 0.3 tonne)	\$7.20 per vehicle	\$8.20 per vehicle
loads over 0.3 tonne	\$30.35 per tonne	\$32.80 per tonne
tree trunks and roots greater than 150 mm diameter	\$50.00 per tonne	\$53.20 per tonne
polystyrene	\$30.35 per tonne	\$576 per tonne (from 1 April 1993)
loads containing more than 25% paper	\$50.00 per tonne	not accepted

Bulk demolition materials are not accepted.

Waste vehicles proceed from the entrance station to the landfill disposal area or recycling centre. Vehicles carrying only separated recyclable materials will be admitted to the depot free of charge.

For safety at the tipping face small vehicles are separated from mechanically unloaded vehicles and tipping vehicles. A separate working face is provided for different vehicle types to maintain this separation. Vehicles leave the site passing again through the entrance station. Exit weight is recorded where necessary to allow calculation of tipping fees.

Facilities are provided for truck washdown so that drivers of waste collection vehicles can remove loose scraps from their waste containers before leaving the site.

2.6.2 Disposal Operations

Waste disposal operations include four separate activities:

- ☐ site preparation;

- ☐ winning cover material;
- ☐ placement, compaction and covering;
- ☐ rehabilitation and aftercare.

Preparation

Construction of an earthen bund along most of the southern site boundary to act as a noise and visual barrier was one of the first functions in preparing Area 4. to receive waste. The bund has been planted with trees and shrubs and fitted with an irrigation system to encourage quick growth.

Stormwater diversion drains have been installed on the uphill side of the landfill and a flood levee will be built along the Eastern Creek boundary of the fill area to prevent floodwater from entering the excavation in the event of a major flood.

Preparation work has also included construction of a sealed road to the southern end of the site and clearing of the first waste disposal cells adjacent to the southern boundary.

Winning Cover Material

Cover material is being extracted progressively from the landfill area. Cover material extraction will progress over the site just ahead of filling operation so that the area of disturbance at any one time is minimised.

Topsoil recovered from the landfill area is used to cover earthen bunds and for spreading over completed parts of the site. The underlying clay/shale material is then ripped with a bulldozer and scooped up with a scraper. Stockpiles of cover material are being created in the south-western corner of the site, to be used for the final stages of the landfill when further extraction is not possible. Extracted material is hauled by scraper either to this stockpile or directly to the waste disposal area where it is deposited above the working face for spreading over compacted waste.

Cover material can theoretically continue to be extracted to any depth, provided the geological and hydrogeological characteristics of the excavation remain suitable for excavation and waste disposal. In practice however, unless there is an opportunity to remove excavated material from the site, extraction only proceeds to the extent necessary to obtain sufficient cover material for the expected volume of waste. Normally the volume of excavation would be about one half of the final volume of the landfill above original ground level.

The contractor may use explosives to assist excavation if this becomes necessary.

Waste Disposal

As waste is deposited at the working face from motor vehicles it is consolidated and compacted by waste compactors. Cover material is then spread over the working area to a depth of 150 mm.

The landfill is raised in a series of layers or "lifts" up to three metres thick. Successive lifts are separated by cover material, graded to encourage shedding of rain water. As the landfill begins to protrude above the excavation, an external wall of cover material is constructed and raised with each lift. Flexible perforated pipes are laid in the above-ground parts of the landfill to assist movement of any leachate within the mound.

When the final height is reached a layer of cover material 600 mm thick is placed over the landfill to form a secure cap and a base for establishment of vegetation. Where topsoil is available it is spread over the filled area as part of the final cap. Figure 2.6 shows an impression of a typical waste disposal operation in clay/shale strata.

Decomposition of organic material in the landfill takes place initially under aerobic conditions. When available oxygen has been consumed, anaerobic decomposition occurs. The result is a compost-like material and landfill gas, primarily made up of methane and carbon dioxide in roughly equal proportions. When decomposition is eventually complete the landfill will become inert.

Revegetation and Aftercare

Area 4 of the landfill will be the largest of the four mounds at Eastern Creek and will be progressively revegetated as sections are completed. The smaller completed mounds in areas 1 and 2 have undergone some revegetation on external walls. These areas are now to be more substantially revegetated following completion of landfilling.

Progressive revegetation for Area 4 will involve seeding and planting completed sections as soon as the final cap has been laid. The purpose of establishing a vegetation cover is to control wind and water erosion and to provide a more acceptable appearance from any viewing locations.

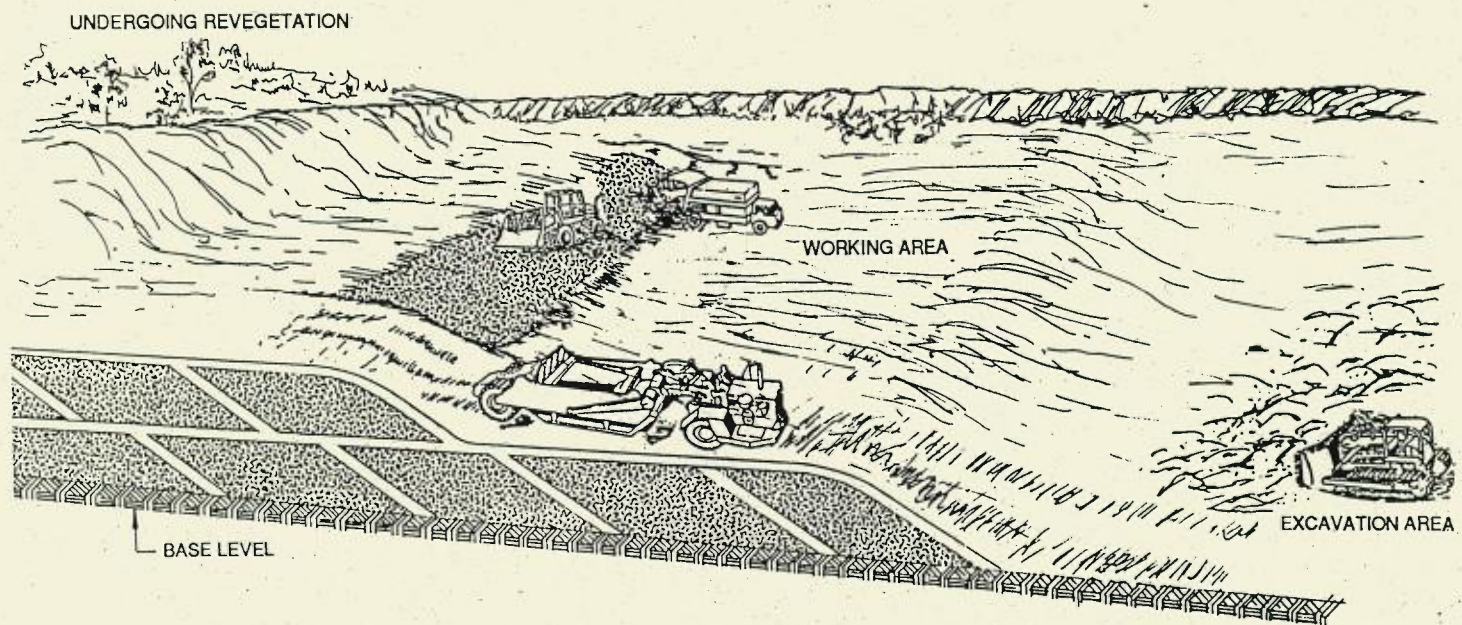
The nature of species to be used in revegetating Area 4 will depend on its final use. At the time development approval was granted for the site, final use was uncertain. The land is part of an open space corridor and intended to become part of a recreation area.

The Waste Service will liaise with the Department of Planning to confirm the latest intentions for the site when selecting revegetation species. In the absence of firm proposals from the

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Figure 2.6

WASTE DISPOSAL OPERATIONS



Department, the area will be stabilised with grass overplanted with indigenous trees and shrubs.

The Waste Service will have aftercare responsibilities on the site to monitor and control leachate, landfill gas, revegetation and soil erosion. This will include monitoring of surface water quality in Eastern and Reedy Creeks and ground water quality in permanent bores installed around the landfill area. Should landfill gas begin to be generated in sufficient quantities to cause a nuisance, apparatus will be installed to collect and dispose of the gas. Should there be doubt as to whether a nuisance is being caused by landfill gas, an odour assessment survey would be undertaken by a qualified air quality consultant. If sufficient gas is available it could be put to use to generate electricity.

Sequence of Operations

Excavation and landfilling have been taking place at the northern end of Area 4 for over twelve months. Operations have commenced in the southern part of the landfill area during 1992 and will progressively fill the site in strips as shown in Figure 2.7. The existing excavation at the northern end will be retained as standby landfill capacity to be used in adverse weather conditions.

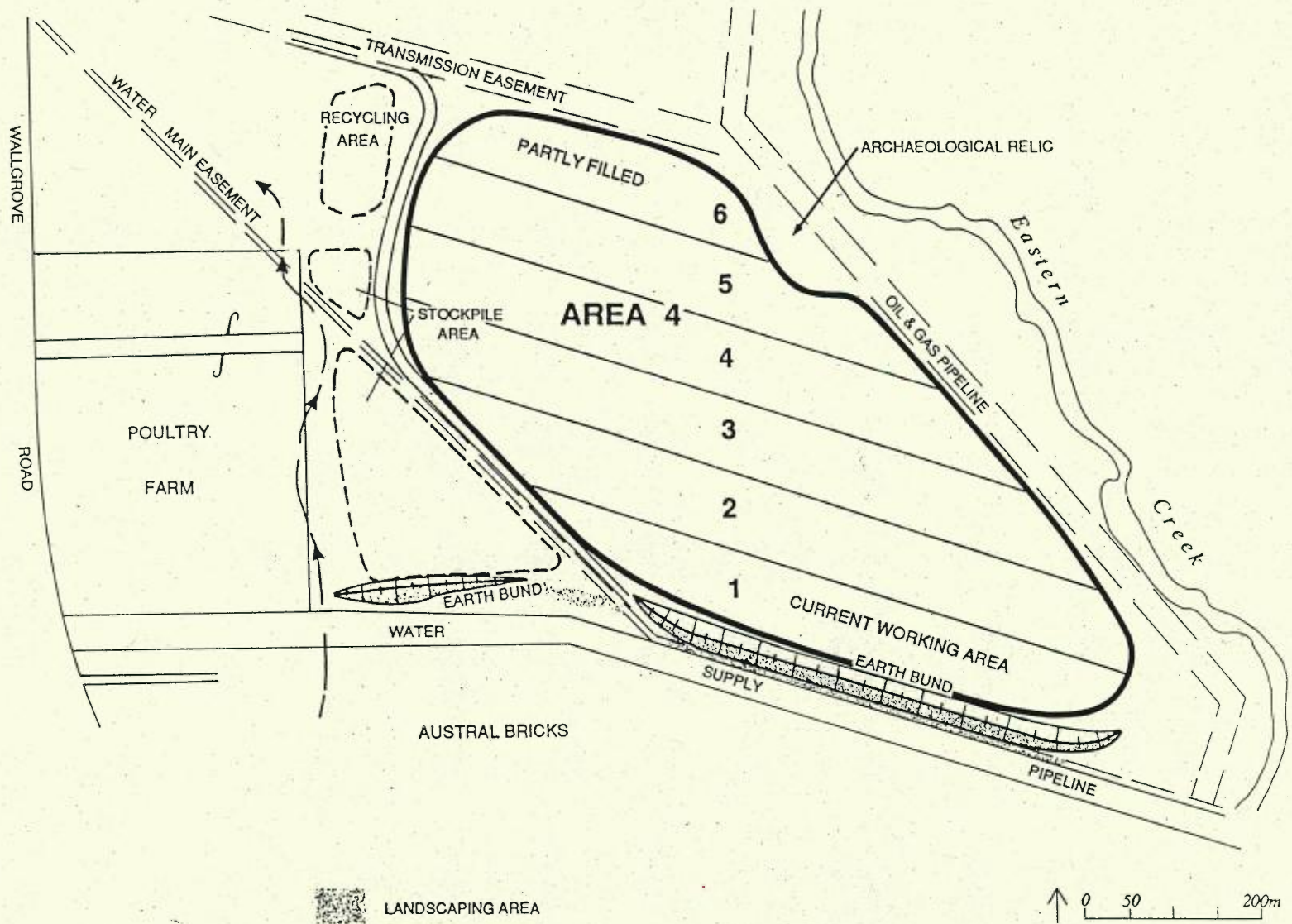
Contractor's Equipment

The depot is operated under contract by J Smit and Sons on behalf of the Waste Service. The contractor supplies and uses the following items of plant;

- ☐ compactors;
- ☐ bulldozers;
- ☐ scrapers;
- ☐ grader;
- ☐ backhoe/front end loader;
- ☐ excavator;
- ☐ water cart;
- ☐ mobile sweeper;
- ☐ truck washing machine;
- ☐ transportable pump;
- ☐ mowing equipment.

The depot is connected to water, telephone and electricity, but is not connected to the sewer.

Figure 2.7 SEQUENCE OF FILLING



2.7 ENVIRONMENTAL CONTROLS

A number of environmental safeguards and controls have been incorporated in the design and operating procedures of the depot. Some controls have been implemented since the commencement of the depot while others are being introduced as workings progress to new areas of the site. Other controls are associated with a later stage of development and will be implemented when needed. Gas control equipment falls into this latter category.

Specific controls are discussed under separate headings.

Waste Covering

Daily covering of waste is the most effective means for preventing environmental problems at the tipping face. Compaction and covering reduces litter, minimises leachate generation, prevents insect or vermin infestation and quickly terminates odours from incoming waste.

Leachate

Leachate is liquid draining from the landfill which has come in contact with waste either before or after the waste is covered. Leachate usually results from waste being deposited in wet weather or from rainwater infiltrating the landfill. There is very little leachate produced at Eastern Creek depot because the clay-based soils restrict infiltration. Furthermore, the majority of waste is deposited during dry weather and is capable of absorbing moisture after being covered. Pump tests and packer tests carried out by D J Douglas and Partners (1993) confirm that the transmissivity of the shale material surrounding the landfill is low to very low. In combination, these factors result in leachate being retained within the landfill.

Operational leachate is surface runoff flowing from the working face during wet weather. It is collected by an earthen bund just behind the working face where it mostly evaporates.

Truck washdown water is collected in a pond and disposed of on site by spray irrigation.

Stormwater and Flooding

Stormwater from covered waste near the working face is directed away from the leachate bund. Runoff from disturbed areas is detained on site by earthen banks, ponds and hay bales.

The south-east corner of the site may be affected by a once in 100 year flood. This will have no effect on completed landfill mounds as the outer wall of earth would not be affected by the low floodwater velocity, predicted to be about three metres per second.

To protect the excavation from possible flooding, an earthen wall will be built around the south east corner of the excavation area.

Noise

The depot is well separated from most other occupied land in the area. Near the eastern end of the southern boundary, Austral Bricks has developed a sales and display area close to the company's boundary fence. To lessen noise propagation from the waste depot into the Austral site an earthen wall has been constructed along much of the southern depot boundary. With this barrier in place noise levels from the depot are predicted to remain within relevant criteria in the brick sales complex and all other occupied buildings in the vicinity of the depot. Noise propagation to the adjoining property to the west is screened by the stockpile of cover material already established near that boundary.

Dust and Odour

Dust is being controlled primarily by sealing permanent roadways leading to landfill areas and water spraying unsealed roads as often as necessary. The Waste Service has agreed with Austral Bricks to cease waste disposal at the southern part of the site during certain wind conditions. Under such circumstances waste disposal operations will move to the standby area at the northern end of landfill Area 4. A wind recorder has been installed at the depot so that wind conditions can be monitored.

Rapid revegetation of completed areas and spraying of stockpiles with a bitumastic binder are also being used to limit dust generation.

Odour is controlled by compaction and covering of waste. Sprays are available for immediate use on offensive loads. When landfill gas begins to be generated, collection and disposal apparatus will be installed if odour becomes a problem. This need cannot be predicted in advance.

Visual

Visual controls have been implemented to restrict visibility of the depot from most public viewing points and from occupied private property. Earthen mounds either side of the entrance roadway limit direct views into the depot from Wallgrove Road. Another earthen bund along the southern boundary restricts viewing from the Austral Bricks sales and display area and its access road. Tree planting has taken place along both embankments to present a more pleasing appearance. Shade cloth has been installed on a section of the southern boundary fence and additional tree planting has taken place within Austral Bricks' property.

Glimpses of the depot are available from the western freeway, but these are of very brief duration.

Vermin and Insects

The depot does not have a problem with vermin. Soon after it opened excessive numbers of silver gulls were found to be visiting the depot and nearby Prospect reservoir. A number of control measures were trialled culminating in the use of "squawkers" which play recorded distress calls at programmed intervals. This deterrent proved to be the most effective measure and has been used at the depot since 1987. Since then there have been insignificant numbers of birds at Eastern Creek depot.

There has not at any time been a problem with rats or insects at the depot as these pests are controlled by daily covering of waste.

Litter

Litter outside the depot is controlled by a daily inspection and pick up on Wallgrove Road along the depot frontage and extending along part of the frontage of neighbouring properties. The Waste Service has also agreed to inspect the access roadway to Austral Bricks sales and display area on a daily basis while waste disposal operations are being carried out on the southern part of the site.

Litter is collected inside the depot as often as necessary, particularly after strong winds. Temporary litter fences are being used at the southern end of the landfill to catch windblown litter.

3. THE PROPOSAL

Chapter 3

THE PROPOSAL

There are two parts to the proposal. Development approval is being sought to:

- ☐ extract additional clay/shale from Eastern Creek waste depot and remove this material from the site to destinations where it is required;
- ☐ continue to operate the waste depot to fill the airspace approved in 1990 and the additional airspace to be obtained by removal of clay/shale.

Operation of the waste depot has been described in Chapter 2 of this document. Extraction of additional clay/shale and its removal from site is described below.

3.1 ADDITIONAL EXCAVATION

Excavation of clay/shale for removal from site will occur within the area of land to be filled with waste. The effect of removing this material will be to deepen the excavation, but will not increase the excavation area.

The type of material to be taken from the site will depend on its intended usage. Brick makers for example, will be very selective of the material they accept. The most desirable lighter burning shale can occur in bands of strata interspersed with material of little or no worth for brick making. Clays from the weathered surface zone also have potential for tile and pipe making and as a blending material in brick manufacture. Other potential users of excavated material such as developers seeking clean fill, or waste depot operators seeking cover material, may not be discriminating as to the type of material accepted.

It will be of no consequence whether the material to be removed from the site comes from near the surface or from deeper strata near the base of the excavation. The Waste Service will not however, allow the natural topsoil to be transported away as this will be required for use in rehabilitation.

3.1.1 Depth of Excavation

During 1991 and 1992 the Waste Service's contractor extracted cover material from Area 4 for use in depot operations. Some of this material was utilised for covering waste in Area 3, some for waste covering in Area 4 and the remainder was stockpiled in the south western corner of the site. Excavation to date has proceeded to a depth of about eight to ten metres below natural ground level.

Excavation can continue in Area 4 until advancing waste disposal operations require all of the area to be covered with waste. The depth of excavation would be limited by the amount which can be excavated during this window of time and the willingness of receptors to take the excavated material. Other factors with potential to influence excavation depth include suitability of material and hydrogeology of the pit.

Eastern Creek depot is sited in Bringelly Shale described by the Department of Mineral Resources as "a complex and variable geological unit comprising claystone, siltstone, laminate and sandstone". Perhaps the best indication of the depth of this material can be gained from the brickworks immediately to the south. The brickworks management advised that extraction has taken place to 40 metres and drilling to 65 metres proving a continuous clay/shale resource.

During 1990, the Waste Service drilled eighteen test boreholes into Area 4 to a depth of approximately twelve metres. Records were made of the time taken for the bore to proceed each metre into the ground. Results indicated a fairly uniform strata across the site with a band of harder material lying generally between three and seven metres depth and a lesser band between nine and eleven metres.

Towards the end of 1992, DJ Douglas and Partners carried out a hydrogeological study of Area 4 (D J Douglas 1993). Five vertical bores were drilled to a depth of 15 metres. After removing the overburden soil with an auger, the bedrock was core drilled to provide a stratigraphic sequence. The results are shown in Table 3.1.

Table 3.1 GENERALISED STRATIGRAPHIC SEQUENCE

Approx. depth to layer interface	Description
Surface	Silty clay/clayey silt/shale filling
3.2 to 4.85	Very low to low strength siltstone and shale, moderately weathered and highly fractured
6.4 to 7.2	Medium strength and high strength fresh slightly fractured siltstone and shale
15.0	

Source: Douglas (1993)

These results confirm the expectation that material in Area 4 will be suitable for excavation and removal from the site. At this stage it is expected that removal of clay/shale might involve excavation for approximately three metres additional depth, below that required for waste disposal operations, over most of the 25 hectare landfill. Provided clay/shale and other suitable strata continue to be encountered, there is no reason why excavation could not proceed to greater depths.

Factors limiting excavation depth will be the rate at which recipients are prepared to receive excavated material and the ever-present requirement for the depot to dispose of incoming waste. Once it becomes necessary to commence waste disposal in any particular working area or cell of the landfill, further extraction in that cell will not be possible.

Without export of clay/shale, the maximum thickness of landfill would be approximately 20 metres (13 metres above natural ground, 7 metres below). An additional three metres of excavation would increase this maximum thickness to about 23 metres.

3.1.2 Excavation, Loading and Stockpiling

At the present time the Waste Service's contractor excavates the site by ripping the bedded shale with a bulldozer and then collecting the material with scrapers. While blasting has not been used at the depot to date, some minor loosening of material with explosives may be required for a deeper excavation.

Material to be transported from the site will be loaded by a tracked excavator into 25-tonne trucks. Alternatively a front end loader may be used for this purpose if the material is pre-ripped by a bulldozer. It is estimated that a 25-tonne truck can be filled by an excavator in approximately three minutes. Allowing for manoeuvring and weighing, a truck could depart from the site about every five minutes, if sufficient trucks were assigned to the task.

Brickworks contacted during preparation of this document indicated that they would wish to supervise excavation of material destined for their works and may take core samples each day for firing to confirm continuing suitability of the material.

The nearest brickworks is just south of the Warragamba-Prospect water pipelines which adjoin the southern boundary of the waste depot. This company has suggested that significant savings could be made if material were to be collected and delivered to its premises by scraper. This could only be achieved if a private haul road were to be developed within another adjoining property so that scrapers could cross the pipelines where they are underground beside Horsley Road. The Waste Service does not wish to pursue that option at the present time and hence it is not part of the current proposal.

The Waste Service would prefer that material to be removed from the site be taken away immediately it is excavated. There is some potential to further stockpile excavated material within the waste depot but this could be on a short-term basis only. Temporary stockpiling could take place over the area still to be used for landfilling, provided topsoil is firstly removed.

The Waste Service may decide to temporarily stockpile additional cover material, if this has to be excavated as overburden to uncover useful clay/shale intended for removal from site. If the recipients of clay/shale wish to carry out some blending of material within the depot site, the Waste Service may agree to temporary stockpiling for this purpose also, provided the stockpile can be confined to the future landfill area and does not interfere with normal depot operations.

3.2 TRANSPORT

3.2.1 Likely Volumes and Destinations

With a single excavator working and trucks dispatched from the depot at the maximum rate of one every five minutes, approximately 2400 tonnes of material could be moved in an eight hour day, carried in 96 truckloads.

The Waste Service has indicated it does not intend to operate more than one excavator on the site, so 2400 tonnes per day is considered to be the theoretical maximum rate of removal.

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The further the destination of trucks however, the lesser will be the rate of removal it would be unlikely that sufficient trucks would be assigned to maintain a five minute dispatch rate.

Discussions have been held with representatives of the Austral Brick Company Pty Ltd, PGH Clay Bricks and Pavers, Boral Bricks (NSW) Pty Ltd and CSR/Readymix. Each company indicated an interest in receiving suitable clay/shale from Eastern Creek waste depot subject to their requirements at the time and satisfactory commercial arrangements being entered into.

Each company was requested to give an indication of the likely maximum volume and rate of acceptance of clay/shale which could be taken if material met the company's requirements and commercial arrangements were satisfactory.

Advice from the four companies was as follows:

Austral: This company operates a brickworks and quarry just a few hundred metres from the waste depot and consequently has a good understanding of the type of strata to be encountered on the site. Austral regards red, white and brown clay and brown shale as suitable material for its needs. This material is expected to be found in the uppermost three metres. Underlying blue shales are of no interest to the company. Subject to suitability and commercial arrangements, Austral envisages accepting the uppermost three metres of material (less topsoil) from the remaining undisturbed part of the landfill area. This amounts to about 500,000 cubic metres or about 0.8 million tonnes. The company would be prepared to stockpile the material in an existing quarry and anticipates a rate of receipt between 2,000 and 3,000 tonnes per day. The company had some doubts however, that the value of this material would warrant its being transported by truck. A private haul road for scrapers or a conveyor system were suggested as possible alternatives.

PGH: This company expressed interest in importing clay to its Horsley Park and Cecil Park brickworks. At the time of discussion about 70,000 to 90,000 tonnes of feedstock was imported annually to the Horsley Park plant from sources further afield than Eastern Creek. Any material taken from the waste depot would substitute for these existing imports and hence would have a net effect of reducing truck kilometres on the road system. The company anticipates that up to 30,000 tonnes of clay/shale could be sourced each year at the waste depot for Horsley Park and 60,000 tonnes for Cecil Park, provided the valued cream burning material was available and satisfactory commercial arrangements could be entered into. The company would expect to take this material over a limited part of the year so that a blended stockpile can be prepared to achieve uniformity. Again a

rate of removal of between 2,000 and 3,000 tonnes per day could be anticipated. The period of the year to shift clay/shale would be determined by the company's need to receive the material. The company may consider taking some poorer quality material subject to commercial arrangements. This would be unlikely to alter the maximum rate of removal, but could extend the period of time during which material transport occurs.

Boral:

This company uses about 120,000 tonnes of light burning clay/shale per annum at its Badgerys Creek plant and will use a similar quantity at the Bringelly brickworks. At the present time adequate supplies of material are able to be won on the sites. However, the company would be prepared to import up to one third of these requirements to both works subject to satisfactory commercial arrangements. This could amount to 40,000 tonnes at each plant per year, transported in three particular months to match the company's cyclic winning and stockpiling program. About 700 tonnes per day would need to be transported to each brickworks under this arrangement.

CSR/Readymix:

Development approval has recently been granted to this company for rehabilitation of the Erskine Park hard rock quarry using non-putrescible waste. The project provides for stockpiled quarry overburden to be used as cover material with the balance being obtained by excavation of adjoining grasslands. The company would be interested in receiving clay/shale from Eastern Creek to eliminate or reduce the need for grassland excavation. Subject to commercial arrangements, and stockpiling capability, the company has the capacity to receive excavated material as it is won from Eastern Creek depot. Cover material imported from Eastern Creek would be stockpiled at the quarry until it required in the quarryfill. On this basis material could be transported to Erskine Park at the rate of excavation. A maximum rate of 2,400 tonnes per day has been used for the basis of impact assessment.

In summary, the three brickworks and one landfill operator which were contacted have expressed interest in receiving clay/shale, provided the material is suitable for their needs and commercial arrangements can be agreed. A general comment received from the brickworks is that a large portion of material likely to be excavated will either be unsuitable for brickmaking or of so little value that its transport would not be justified. Each of the brickworks has its own supplies of poorer quality material. Under these circumstances the Waste Service may find that the bulk of material is directed to destinations other than brickworks.

Table 3.1 summarises advice received from the four companies contacted.

Table 3.1 ACCEPTANCE OF CLAY/SHALE

Company	Maximum quantity suggested	Maximum rate of acceptance <i>tonnes/day</i>
Austral No. 2 Horsley Park	800,000 tonnes	2,400
PGH Horsley Park	30,000 t/y	2,400
PGH Cecil Park	30,000 t/y	2,400
Boral Badgerys Creek	40,000 t/y	700
Boral Bringelly	40,000 t/y	700
CSR/Readymix Erskine Park	unlimited	2,400

It would not be possible for all potential recipients to import material simultaneously at the maximum suggested rate. The light-burning shale valued by brickworks is not predicted to be present in sufficient quantity to allow this to occur. Even if abundant resources were available, practical limitations at the waste depot will restrict the rate of removal. A probable scenario is that the Waste Service will despatch excavated material to one recipient at a time at the rate of extraction, depending on commercial arrangements. As with any extractive industry the precise destination of the product is subject to negotiation with potential "customers" from time to time.

3.2.2 Transport Routes

Figure 3.1 shows the location of identified potential recipients of clay/shale. Although Eastern Creek waste depot is in the City of Blacktown, three potential recipients are in the City of Fairfield, two in the City of Liverpool and one in the City of Penrith.

Other destinations for excavated material may emerge in future years. The Waste Service will make excavated material available to any lawful recipient subject to favourable commercial terms, the quantities which are required and the rate of removal.

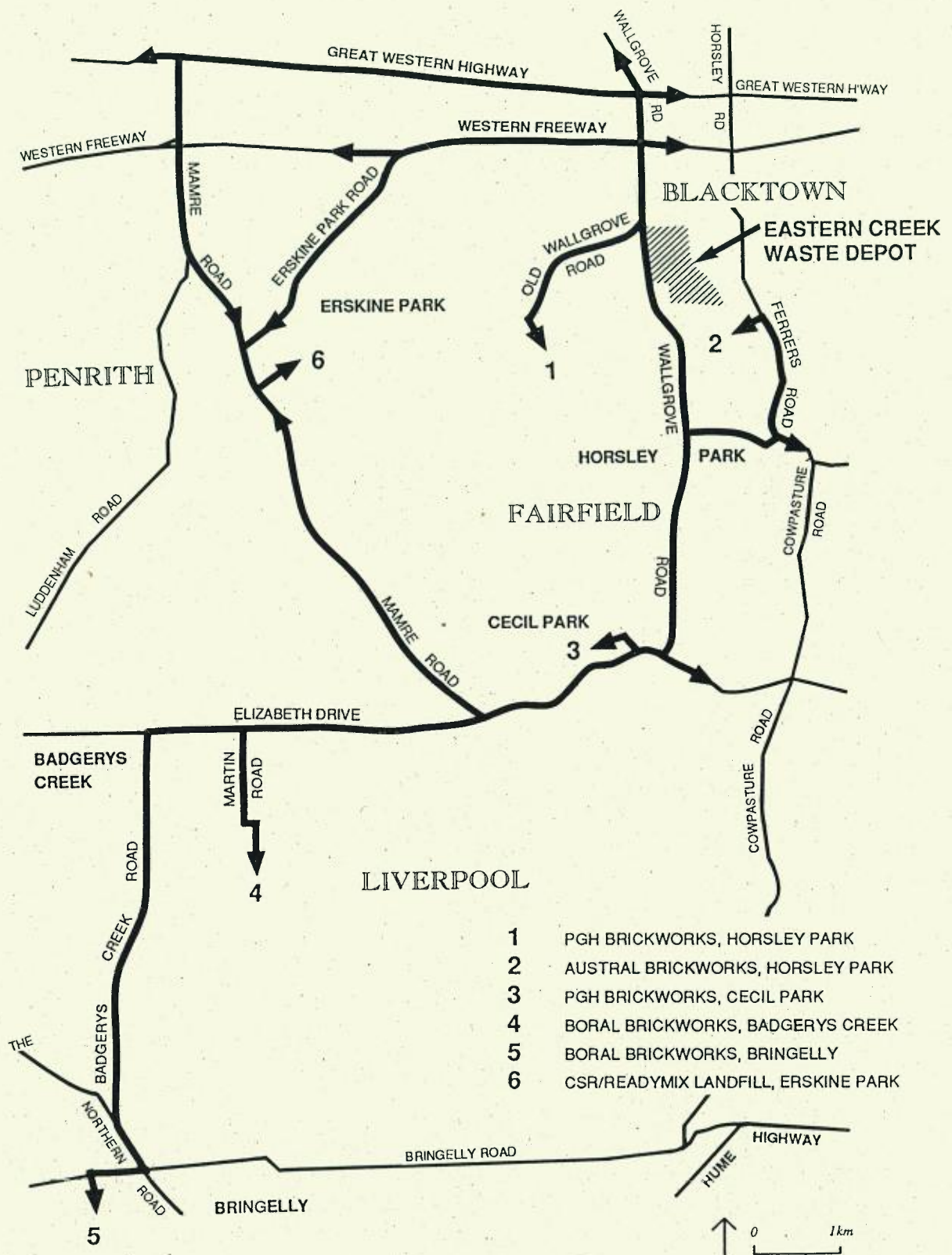


Figure 3.1 POTENTIAL TRANSPORT ROUTES FOR CLAY/SHALE

Transport routes highlighted on Figure 3.1 are as follows:

1. **PGH, Horsley Park:** via Wallgrove Road and Old Wallgrove Road, 3 km
2. **Austral No. 2, Horsley Park:** via Wallgrove Road, The Horsley Drive, Ferrers Road, 7 km
3. **PGH, Cecil Park:** via Wallgrove Road, Elizabeth Drive, Cecil Road, 7.5 km
4. **Boral, Badgerys Creek:** via Wallgrove Road, Elizabeth Drive, Martin Road, 17 km
5. **Boral, Bringelly:** via Wallgrove Road, Elizabeth Drive, Badgerys Creek Road, The Northern Road, Greendale Road, 25 km
6. **CSR/Readymix, Erskine park:** via either –

Wallgrove Road, Western Freeway, Erskine Park Road, Mamre Road, 12 km; or

Wallgrove Road, Great Western Highway, Mamre Road, 17 km; or

Wallgrove Road, Elizabeth Drive, Mamre Road, 19 km.

Heavy vehicles are permitted on all of the nominated roads. Controlling authorities for the roads are as follows:

- ☐ Roads and Traffic Authority – Wallgrove Road, The Horsley Drive, Elizabeth Drive, The Northern Road, Western Freeway, Great Western Highway and Erskine Park Road;
- ☐ Blacktown City Council – Old Wallgrove Road;
- ☐ Fairfield City Council – Ferrers Road, Cecil Road;
- ☐ Liverpool City Council – Martin Road, Badgerys Creek Road, Greendale Road.

3.2.3 Vehicle Numbers and Times

It is anticipated that standard 25-tonne bogie trucks will be used to transport excavated material from the site. At a maximum expected rate of 2,400 tonnes per day, 96 truckloads would be required.

For comparison purposes, for the twelve month period to March 1991 an average of about 315 waste trucks visited the depot every day. The weekday average was higher than this figure as the majority of truckloads arrive from Monday to Friday. During 1992, restrictions on commercial and industrial waste reduced truck numbers to an average of 162 trucks per day. Further restrictions later this year, partially offset by the effects of closure of Grange Avenue depot, will reduce waste truck numbers to an estimated 145 trucks per day. Clay/shale trucks would replace some of the reduction in commercial waste vehicles, still resulting in a significant reduction in truck numbers from 1991 levels.

Removal of clay/shale from the site will be permitted between the hours of 7 am and 3 pm Monday to Friday. This will closely match present patterns of activity on the depot site. At weekends only minor excavation is carried out to cover the small portion of waste received on those days. It is not proposed to introduce a major work change at this low activity time of the week.

3.3 CONSEQUENCES FOR THE DEPOT

3.3.1 Waste Disposal Operations

Removal of clay/shale from the depot will not have any significant effect on waste disposal operations. The sequence of filling the remaining landfill area will not be altered, but it will take more time to fill each segment or cell owing to the greater quantity of waste accommodated within the deeper excavation.

Export of clay/shale will require the area being excavated at any one time to be slightly larger than would be required for extraction of cover material only. This is because of the physical requirements of excavating to greater depths (longer access ramps and side batters) and the need to provide an area for truck loading as well as scraper operation. If clay/shale suitable for brickmaking is found to lie below unwanted material, the Waste Service may choose to excavate the overburden and temporarily stockpile on site for progressive use as cover material. Such temporary stockpiling would occur either on existing stockpile areas or within the area proposed for landfilling.

The proposal will not alter the hours of opening of the depot but may require employment of one extra person to operate the excavator on a more continuous basis than at present. Work opportunities will also be created for private truck operators.

3.3.2 Extension to Depot Life

The purpose for extracting additional clay/shale and removing it from site is to increase the capacity of the depot for waste disposal and hence extend its life. As indicated in Section 3.1.1 it is expected at this stage that removal of clay/shale will permit an extra three metres of excavation over most of the 25 hectare landfill Area 4.

If suitable arrangements can be made for recipients to take this volume of material it will increase the remaining capacity of the depot by approximately 50% and extend the life of waste disposal operations by a further two to three years. Removal of clay/shale would cease approximately two years before landfilling is completed as it would then be necessary to cover the final cell of the excavation with waste and complete the mound to approved contours.

3.3.3 Environmental Safeguards

Environmental effects of the proposal will largely be controlled by safeguards already incorporated into depot design and operating procedures. Some specific environmental safeguards to be modified or introduced with the proposal are outlined below:

Containment

Should deeper excavation uncover significant discontinuities in the strata or other defects which call into question the ability of the ground to contain leachate, the Waste Service will seal such locations with a clay barrier. This same safeguard is available for use in current depot operations but has not been required to date.

Water Management

Leachate containment will be unaltered as a result of the deeper excavation. The area of the landfill is not being changed, hence exposure to rainfall will not alter. Operational leachate, surface runoff from the working face, will be generated for a longer period of time because of the extension to depot life. This liquid will be disposed of by evaporation or land spraying, as at present.

Stormwater management will be adjusted to take account of the larger area of excavation required at any one time and any temporary stockpiles of extracted material.

Gas Control

A deeper landfill can increase surface concentrations of landfill gas. A second factor pointing to this outcome is the increased proportion of putrescible waste now being received

at the depot, resulting from restrictions on commercial and industrial waste. The need for installation of a gas extraction system will be monitored, as before.

The Waste Service has already undertaken to install gas extraction apparatus at the depot, if this becomes necessary.

Dust

A faster rate of excavation will result in more intense usage of unsealed operational roads within the depot. The Waste Service's contractor will consequently be required to increase the rate of application of dust suppression sprays as necessary to ensure air quality objectives are met. Dust control measures will also be extended to any temporary stockpiles of cover material.

Noise

The only additional machinery to be introduced to the depot will be haulage trucks. The depot operator already uses an excavator on the site when required. Peak noise levels from excavation plant will therefore not increase, although the operation of machinery will become more continuous at times when trucks are being loaded. The depot's neighbours are safeguarded by distance and physical barriers from excavation noise on the site. A limitation of working hours to between 7 am and 5 pm Monday to Friday, will ensure the existing noise regime will not be changed on weekends or at night.

The noise level from trucks hauling clay/shale from the site requires no further safeguards as the number of these vehicles, when added to waste vehicles currently visiting the site, will still be fewer than average daily truck numbers entering the site during the whole of 1991 and preceding years.

4. ENVIRONMENTAL ASSESSEMENT

ENVIRONMENTAL ASSESSMENT

The existing environment likely to be affected by the proposal is that of an operating waste disposal depot. Extraction of additional clay/shale and its removal from site will be an ancillary activity which will not alter the character of operations in the depot. Many users of the depot may not discern that the ancillary activity was occurring.

Extraction of clay/shale for removal from any location will not occur until the extraction area has been cleared and stripped of topsoil for the purposes of waste disposal. Clay/shale removal will not create a need to disturb any new areas of land. The additional work at the depot will take place entirely below ground level within excavations that are created for waste disposal purposes. The functioning of water management structures and water quality controls at the waste depot will be little affected by deeper excavation. There will be very little effect on waste disposal operations and depot management.

The existing environment also includes the road network upon which clay/shale may be transported to its destination and the traffic conditions pertaining to those roads.

This environmental assessment considers environmental matters relevant to the proposal by describing the existing environment, explaining the changes which will occur and examining the likely effects of those changes for each issue. One effect of the proposal is an extension in the life of the depot which would require a continuation of existing operational impacts for a further period estimated to be two to three years beyond the current five-year life expectancy.

4.1 LAND USE AND PLANNING

The site of the proposal is a solid waste depot, operated by the Waste Recycling and Processing Service. Surrounding land uses are indicated on Figure 4.1 and include poultry farming, quarrying, grazing, cleared vacant land, brickworks, a brick sales centre, above ground water supply pipelines, a racing circuit and a theme park.

The nearest residence to the site is on the poultry farm fronting Wallgrove Road, a few hundred metres west of the depot boundary. Other dwellings are located 400–500 metres east of the site along Horsley Road.

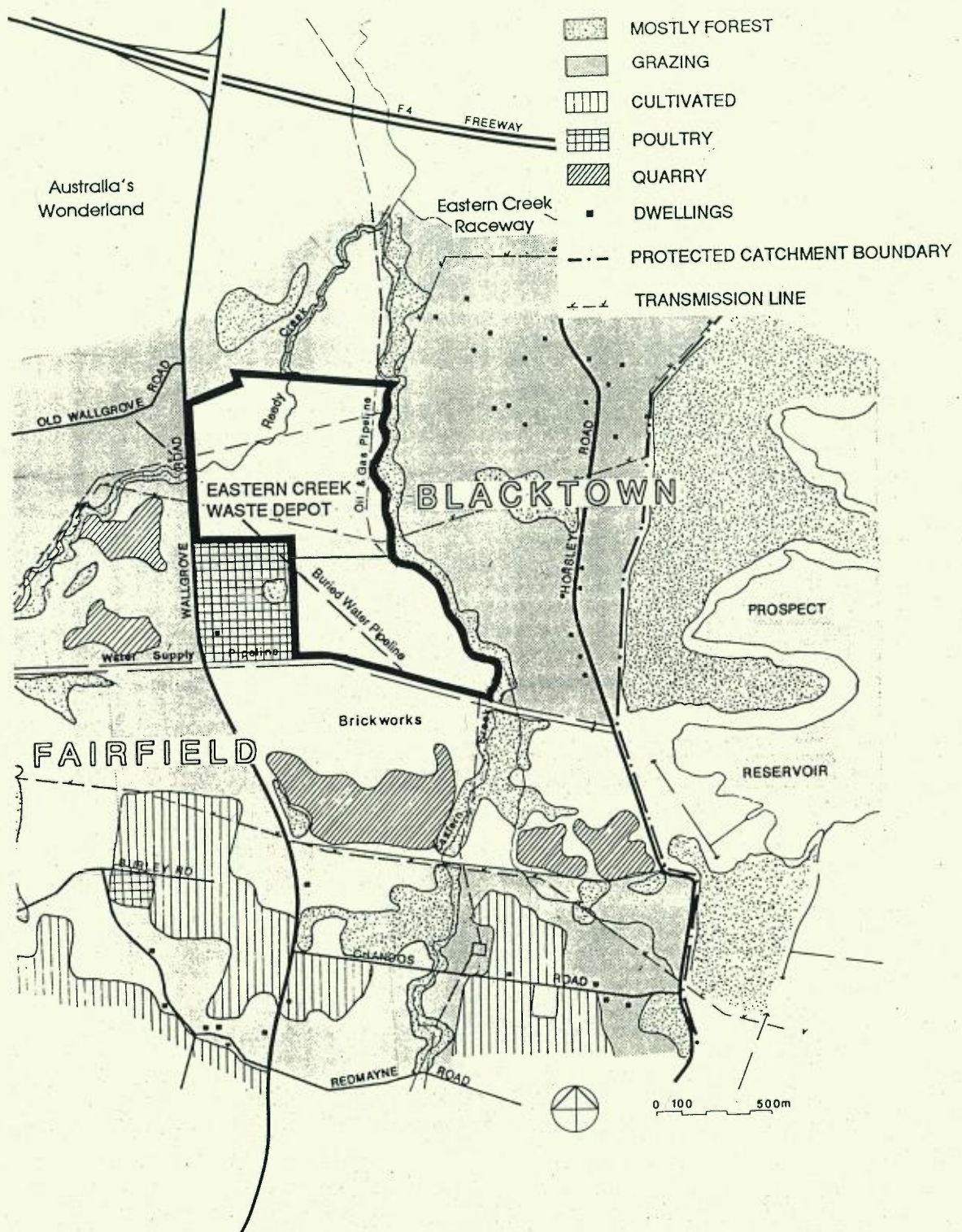


Figure 4.1 SURROUNDING LAND USE

The waste depot is traversed by two electricity transmission lines and three buried pipelines for oil, gas and water.

The site is within the City of Blacktown, just north of the boundary with the City of Fairfield. The local government boundary is along the southern side of the Water Board's Warragamba - Prospect pipeline.

The site was formerly zoned 5(a) Corridor under the City of Blacktown Local Environmental Plan, 1988. In October 1989 however, the site and some adjoining land was excised from the LEP by State Environmental Planning Policy No. 29 - Western Sydney Recreation Area. SEPP 29 is primarily aimed at enabling the development of a recreation area of State significance. Another aim of the policy is to allow development for public authority undertakings and infrastructure to be carried out.

Clause 9 of the SEPP provides that "a public authority may, with the consent of the Minister, carry out development for any purpose in the exercise of its functions". The Waste Service is a public authority and the proposed removal of clay/shale is being carried out for the purpose of extending the life of a waste disposal depot. Hence, the proposal is permissible with the consent of the Minister for Planning.

Sydney Regional Environmental Plan No. 20, Hawkesbury-Nepean River provides a framework for planning along the Hawkesbury-Nepean valley. Most of the City of Blacktown including Eastern Creek waste depot is affected by the plan. The aims of the plan in relation to extractive industries are intended to protect the river, its water quality and wildlife habitats. Consent authorities are required to ensure that proposed developments are consistent with the aims of SREP 20 before granting consent and to take into account the following matters:

- ☐ water quality;
- ☐ significant vegetation habitats (including wetlands);
- ☐ extraction;
- ☐ environmental heritage and scenic quality;
- ☐ recreation and tourism;
- ☐ agriculture;
- ☐ the planning report accompanying SREP 20; and
- ☐ representations made by public authorities.

The Department of Planning has identified water quality as the potential issue of most relevance to the river system from the proposal at Eastern Creek depot.

Sydney Regional Environmental Plan No. 9 - (Extractive Industry) is aimed primarily at facilitating the development of extractive resources in the Sydney Metropolitan Area. In relation to the Eastern Creek waste depot site, the plan's objective is to ensure that

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encroachment by urban development does not prevent existing extractive industries (nearby clay quarries owned by brickworks) from realising their full potential.

The operative Clause in SREP No. 9 for this site is Clause 12 which provides that the Council shall not consent to development on the land except with the concurrence of the Secretary of the Department of Planning and the Director of the Environment Protection Authority. The Council however, is no longer the consent authority, by virtue of SEPP 29 – this role has passed to the Minister for Planning. Since SREP 9 binds only the Council and not the consent authority, it has no bearing on determination of the application.

Notwithstanding that concurrence is not required, the Department of Mineral Resources has indicated agreement with the proposal and identified merit in winning the clay/shale resource for productive purposes.

4.2 ROADS AND TRAFFIC

4.2.1 Study Area and Road Network

Eastern Creek waste depot is located off Wallgrove Road about 1.6 kilometres south of the F4 Freeway. The area considered in the traffic analysis extends from the Great Western Highway in the north to Bringelly in the south and is shown in Figure 3.1. Within this area are several likely recipients for extracted clay/shale from the depot. The major roads within this area are:

- ☐ Western Freeway;
- ☐ Great Western Highway;
- ☐ Wallgrove Road;
- ☐ The Horsley Drive;
- ☐ Elizabeth Drive;
- ☐ Badgery's Creek Road;
- ☐ Mamre Road;
- ☐ Erskine Park Road.

The Western Freeway and The Great Western Highway are the major east-west arterial routes in the area. The Western Freeway is a four lane freeway standard road that has ramp intersections at Wallgrove Road (all directions), Erskine Park Road (east facing ramps only) and Mamre Road (west facing ramps only).

The Great Western Highway is a six lane divided arterial road with traffic signal controlled intersections at the major cross roads; Wallgrove Road, Minchin Drive, Carlisle Avenue, Roper Road, Bennett Road, Sydney Street, Glossop Street and Mamre Road.

Wallgrove Road provides access to the waste depot. Wallgrove Road is an arterial road (MR515) and extends from the Great Western Highway to Elizabeth Drive. It is a two lane roadway over most of its length, with a travelled way of about seven metres. The section of road from the F4 Freeway to the intersection with Old Wallgrove Road is a divided carriageway with two traffic lanes in either direction. The intersection of the waste depot access road with Wallgrove Road provides for a NAASRA Type B right turn facility. This layout allows traffic from the south to pass vehicles turning right into the waste depot.

Wallgrove Road intersects with The Horsley Drive about 3.2 km south of the waste depot entrance. The intersection is a roundabout with localised road widening to four lanes on the approach to the roundabout entry. A large proportion of the traffic travelling along Wallgrove Road is travelling to or from the Fairfield/Bosley Park area and uses The Horsley Drive as the main route.

The Horsley Drive from Wallgrove Road to Ferrers Road is a three lane roadway with a 10 metre travelled way width. Wallgrove Road between The Horsley Drive and Elizabeth Drive has recently been reconstructed to provide a concrete pavement and a seven metre carriageway width. A new roundabout has recently been completed at the junction of Wallgrove Road and Elizabeth Drive.

Elizabeth Drive from Wallgrove Road to Badgery's Creek Road is a two lane roadway with a seven metre travelled way. There is one section of road between Mamre Road and Duff Road where there is an additional climbing lane for eastbound traffic. Badgery's Creek Road is a relatively lightly trafficked two lane rural road.

Mamre Road and Erskine Park are both classified main roads. These roads serve the developing urban areas of St Clair and Erskine Park, the rural areas between Erskine Park and Kemps Creek and a proportion of through traffic from other parts of the Sydney Metropolitan Area.

Mamre Road is a high standard two lane rural road from Kemps Creek through to just south of the Western Freeway. There are high standard rural type C intersections at the CSR Readymix access to the south of Erskine Park Road and at the Erskine Park Road T-intersection. Mamre Road is a four lane road between the Western Freeway and the Great Western Highway.

The major proportion of Erskine Park Road is a four lane divided urban road with restricted property access at the frontages and protected right turn bays within the grassed median strip at major intersections. Erskine Park Road has a short 1.5 km rural section at the southern end which has recently been improved by the RTA. This short rural section is relatively lightly trafficked.

4.2.2 Existing Traffic Volumes

The Roads and Traffic Authority regularly records traffic volumes on the arterial roads in the study area. Table 4.1 shows the flows recorded between 1981 and 1989, the year of latest published figures.

Table 4.1 EXISTING TRAFFIC VOLUMES (AADT)

Road	1981	1983	1985	1987	1989
Western Freeway (E of Wallgrove Rd)	19320	22680	23976	37864	40527
Great Western Freeway (Ropers Creek)	33580	36640	39988	33520	39341
Wallgrove Road (South of F4 Freeway)	18890	19160	21316	24383	28571
Wallgrove Road (North of Elizabeth Drive)	8530	8990	8866	8585	9671
The Horsley Drive (East of Wallgrove Rd)	11240	11210	14388	16629	20374
Elizabeth Drive (West of Wallgrove Rd)	11010	12010	15510	16070	16527
Elizabeth Drive (West of Mamre Rd)	7920	8330	8408	9264	10330
Mamre Road (St Marys)	10420	12400	15234	18417	-
Mamre Road (Kemps Creek)	5750	7190	8550	8346	-
Erskine Park Road (N/Chatsworth)	-	-	2650	10430	-
Erskine Park Road (N/Lenore Lane)	-	-	1570	2000	-

Sources: Roads and Traffic Authority, New South Wales, "Traffic Volumes and Supplementary Data - Sydney, Parramatta & Blacktown Division and Penrith City Council counts for Erskine Park Road.

The traffic volume at the entrance to the waste depot on Wallgrove Road is lower than the 28,571 vehicles per day recorded at the Freeway because of the traffic contribution from Australia's Wonderland and developments along Old Wallgrove Road. The table indicates that there is a significant drop in the traffic volume on Wallgrove Road south of The Horsley Drive intersection suggesting that a large proportion of the Wallgrove Road traffic turns into The Horsley Drive. Traffic volumes in the area have shown a steady growth since 1981. The average growth rate is between 4% and 5% per annum.

Peak traffic volumes on Wallgrove Road occur between 7 am and 8 am and between 5 pm and 6 pm. The clay/shale extraction traffic would be generated between 7 am and 3 pm and would generally only coincide with peak hour traffic during the morning peak. In the morning peak the major flow is southbound. The morning peak volume is about 2410 vehicles per hour, (1760 southbound and 650 northbound). Sample surveys undertaken in August 1991 indicate that heavy goods vehicles comprise about 8% of the total traffic on Wallgrove Road. 6% on Mamre Road and 3% on Erskine Park Road.

4.2.3 Former Traffic Levels at Eastern Creek

In its Annual Report for 1990/91 the Waste Service indicated that for the 12 month period from 1 April 1990 to 31 March 1991 a total of 115,211 trucks and 85,668 light vehicles entered the Eastern Creek waste depot, see Table 4.2. This is an average of 550 vehicles per day. These traffic levels were experienced prior to restrictions on commercial and industrial waste, introduced in January 1992. Previous traffic studies (GHD, 1989) have shown that only 20% of depot traffic originates from the south. Average payload per truck carrying domestic garbage was 5.5 tonnes. The average for vehicles carrying commercial and industrial waste was 2.5 tonnes.

Table 4.2 WASTE DEPOT TRAFFIC (1990/91)

Vehicle Type	Annual Flow	Average Daily
Light Vehicles	85,668	235
Trucks	115,211	315
Total	200,879	550

4.2.4 Clay Haulage Traffic

A probable maximum of 2400 tonnes per day which represents an upper limit of 625,000 tonnes per annum could be transported from Eastern Creek site to brick factories or other recipients. Some potential users of the clay have been identified in Section 3.2.1.

It has been assumed that clay/shale will be transported in triaxle articulated tippers, capable of carrying 25 tonnes. The average load per truck is assumed to be 18 cubic metres. This equates to about 96 truck loads per day from the site. The worst case situation will be if all 96 truck loads are headed either north or south on Wallgrove Road. It is assumed the clay will be transported using contractors, this will mean that the trucks will be garaged off-site at night. Truck drivers will bring the trucks from overnight storage to the waste depot each morning and remove them from the run each afternoon.

4.2.5 Regional Traffic Impacts

The traffic impact of clay/shale transport trucks has been conservatively assessed on the basis that all 96 truckloads in any one day can potentially travel on any one of the possible transport routes outlined in Figure 3.1.

A summary table of existing daily traffic and truck volumes on the major transport routes is presented in Table 4.3 to illustrate the maximum potential increases in truck traffic that could result from clay extraction. Haulage of clay/shale could generate a maximum of 96 truckloads (192 truck movements) on any particular day on any of the roads in Table 4.3.

Clay/shale haulage traffic would have minimal impact on existing truck traffic volumes on the Western Freeway and Wallgrove Road which are the major truck routes in the study area. The truck traffic volume increases would be less than 10% on these roads at times of peak clay extraction at Eastern Creek.

Table 4.3 POTENTIAL TRUCK TRAFFIC INCREASES RESULTING FROM CLAY HAULAGE

Road	Existing Daily Traffic Volume 1989 or 1991	Percentage Heavy Vehicles	Existing Heavy Vehicle Volume Per Day	Maximum % Truck Increase with Clay Haulage
Western Freeway of Wallgrove)	41 000	7%	2900	+ 7%
Great Western Highway (at Ropes Creek)	39 000	2%	800	+ 24%
Wallgrove Road (South of F4)	29 000	8%	2300	+ 8%
Wallgrove Road (North of Elizabeth Dr)	10 000	6% (EST)	600	+ 32%
The Horsley Drive (East of Wallgrove)	20 000	6% (EST)	1200	+ 16%
Elizabeth Drive (at Wallgrove)	17 000	6% (EST)	1000	+ 19%
Elizabeth Drive (West of Mamre)	10 000	6% (EST)	600	+ 32%
Mamre Road (at F4)	20 000	5%	1000	+ 19%
Mamre Road (South of Erskine Park)	11 500	6%	700	+27%
Erskine Park Road (South of Chatsworth)	14 500	3%	500	+38%

(EST) estimated from traffic on other roads in the area.

Clay/shale haulage traffic would represent potential increases of between 16% and 38% on the other major roads in the study area: The Great Western Highway, Horsley Drive, Elizabeth Drive, Mamre Road and Erskine Park Road. These increases would be noticeable on peak days for clay haulage when traffic from Eastern Creek used either of these routes. However on an overall annual basis the truck traffic volume increases would be of more marginal significance.

Clay/shale haulage traffic would be potentially significant in the short term on Erskine Park Road which currently carries the lowest volume of truck traffic of the transport routes in Table 4.3. Erskine Park Road has until recently been used primarily by the residential traffic from the suburbs of Erskine Park and St Clair with only a relatively small proportion of commercial traffic from other sources such as the former Readymix quarrying operations at Erskine Park.

In the future, general traffic and truck traffic volumes using Erskine Park Road are projected to increase significantly as a result of the future employment area development at the south of Erskine Park and the future waste depot operations at the Readymix quarry site. The background truck traffic volumes using Erskine Park Road are projected to increase by more than double during the next ten years.

The potential truck traffic increases from clay haulage traffic are relatively short term and are of much lower significance than the overall long term traffic growth projections for Erskine Park Road. The carriageways of Erskine Park Road have been constructed with due regard to its longer term planned function as a major arterial route of regional significance. The road has dual carriageways with sealed shoulders, a wide median strip with protected right turn bays, restricted property access at the frontages and generally adequate setbacks for adjoining residential properties.

The assessment of potential transport routes in Table 4.3 does not include the final sections to the various nominated destinations which generally involve minor roads. These roads, Old Wallgrove Road, Ferrers Road, Cecil Road, Martin Road (Badgerys Creek), Bringelly Road (West of Bringelly) and Erskine Park Road (South of Lenore Lane) are all relatively lightly trafficked by general traffic but have significant existing truck traffic as a result of the commercial/industrial operations served. The addition of clay haulage traffic from Eastern Creek is not therefore considered to be significant on these roads.

4.2.6 Local Traffic Impacts

The future peak hour turning traffic impacts have also been investigated for morning peak hour traffic conditions, 7 am to 8 am, at the Wallgrove Road access to Eastern Creek, for the potential worst case situations, whereby 96 daily truckloads would be headed either north or south from the site.

Restrictions on commercial and industrial waste at Eastern Creek have reduced traffic levels at the depot. Average daily truck traffic in the eight months to February 1993 was 162 trucks which is about half of the daily average in 1990/91 of 315 trucks per day. When restrictions are tightened in 1993 a further reduction in trucks will occur amounting to about 42 trucks per day. Expected redirection of Blacktown Council waste following closure of Grange Avenue depot will add approximately 25 trucks per day to Eastern Creek. Combining these predicted changes with the addition of clay haulage trucks results in a net reduction of about 74 trucks per day on average since 1990/91.

The existing and future turning traffic volumes at the Eastern Creek depot entry on Wallgrove Road have been estimated and are compared in Figure 4.2 for the following situations.

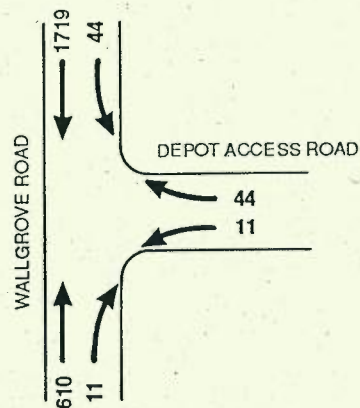
- i. Site Background Traffic in 1990/91.
- ii. Site Background Traffic in 1992 with no commercial or industrial waste traffic.
- iii. Future total traffic with additional clay extraction traffic directed 100% to and from the north.
- iv. Future total traffic with additional clay extraction traffic directed 100% to and from the south.

Predicted turning traffic with additional clay haulage trucks is lower than turning volumes experienced in 1990/91. Traffic leaving the depot and turning right is within the absorption capacity of traffic on Wallgrove Road at all times of the day. This is true even after allowance of a heavy vehicle equivalence factor of 2.0 for turning vehicles, which includes a high percentage of heavy vehicles.

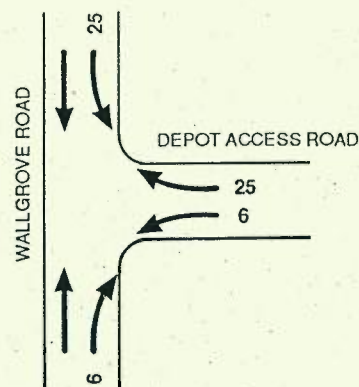
4.3 WATER QUALITY

4.3.1 *Surface Water*

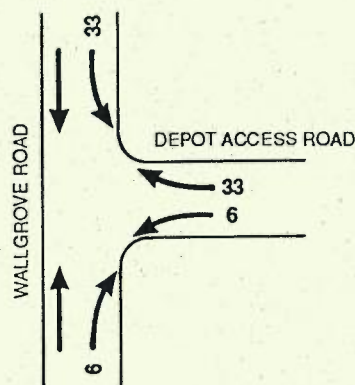
The depot drains to Eastern Creek and Reedy Creek which are shown on Figure 2.4. A tributary of Reedy Creek occasionally flows through the property entering at the south-western corner and passing over a dish drain near the depot weighbridge. Reedy Creek flows between existing landfill mounds and joins Eastern Creek north of the property.



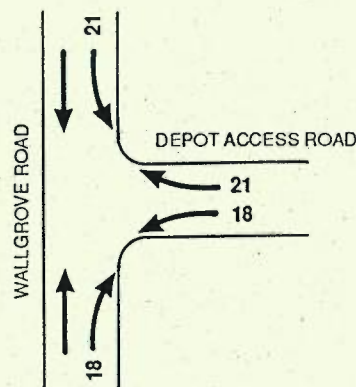
i) INTERSECTION TRAFFIC 1990/91



ii) TURNING TRAFFIC IN OCTOBER 1992
AFTER REDUCTION IN COMMERCIAL
WASTE



iii) POTENTIAL TURNING TRAFFIC AFTER
MID 1993 WITH CLAY EXTRACTION,
TRAFFIC 100% TO NORTH



iv) POTENTIAL TURNING TRAFFIC AFTER
MID 1993 WITH CLAY EXTRACTION,
TRAFFIC 100% TO SOUTH

NOTE: 1. THROUGH TRAFFIC VOLUMES BASED ON A 1991 SURVEY
2. DEPOT TRAFFIC BASED ON DEPOT RECORDS
3. WASTE TRAFFIC WILL REDUCE IN MID 1993 WITH TIGHTENING
OF RESTRICTIONS ON COMMERCIAL WASTE.

Figure 4.2

PEAK HOUR TURNING TRAFFIC AT THE DEPOT ENTRY

Landfill Area 4 is almost entirely in the immediate catchment of Eastern Creek. When the landfill rises above ground level, the western extremity of this mound will drain towards the tributary of Reedy Creek.

Excavation of clay/shale is underway in Area 4. During wet periods stormwater is trapped in a sump in the excavation and can be pumped to a surface pond if required after an appropriate settling period.

The Waste Service has sampled water in Eastern Creek and Reedy Creek on a regular basis since 1984 as part of an ongoing water quality monitoring program which covers all depots.

DJ Douglas (1993) presented the results of recent sampling on Reedy Creek both upstream of the depot (location EC5) and downstream (EC4). Reedy creek flows through the depot passing between completed landfill mounds. Water quality in the creek is similar for water entering and leaving the site. If leachate from the depot were to be entering the creek, this would be expected to appear as an increase in ammonia concentration in the water. In fact the opposite appears to have occurred. Over the last twelve months ammonia has been detected in only one sample for creek water leaving the site (11 milligrams per litre) compared to five samples for creek water entering the site (up to 25 milligrams per litre).

The depot operator has implemented controls to prevent contamination of surface water from leachate or silt-laden runoff. Extraction and removal of additional clay/shale will not alter the effectiveness of those controls or create any new impacts on water quality in the Hawkesbury-Nepean River.

4.3.2 Ground Water

DJ Douglas and Partners (1993) undertook a study of the hydrogeology of landfill Area 4. The review included drilling and sampling of the rock and groundwater, permeability testing of the underlying strata and review of all relevant data.

The findings of the study are as follows:

- ☐ the site is underlain by 3 to 5 metres of clay over shale and siltstone;
- ☐ there is a dyke passing through landfill Area 4 trending towards Eastern Creek;
- ☐ the hydraulic conductivity of shale/siltstone is low to very low;
- ☐ the groundwater chemistry is consistent with uncontaminated water in Bringelly shale;

- ☐ there appears to be a low potential for leachate movement.

The dyke discovered by Douglas was subjected to packer tests which demonstrated that it is of low permeability and should not significantly affect the water transmission characteristics of the bedrock.

Douglas and Partners concluded that the existing depot is not impacting on groundwater quality and that there is no indication of leachate entering the groundwater system. Although the study was based on a limited number of bores, further investigation was not considered necessary given the results already obtained and noting that natural groundwater in the Bringelly Shale is too saline to be used either for consumption or agricultural purposes. Boreholes drilled by D J Douglas will be used for ongoing monitoring of groundwater around landfill Area 4.

In summary, the existing water management controls at the depot are considered adequate to prevent the depot from polluting surface water or groundwater. Water from the depot presents no risk to Prospect Reservoir which is located about one kilometre away across a watershed in the catchment of the Georges River. Water management controls will remain in place beyond the completion of the landfill. Their effectiveness will not be altered by an increase in remaining depot life.

4.4 NOISE

The proposed removal of clay shale will not significantly alter the existing noise regime on the site. Additional excavation and haulage of clay/shale from the site will use the same types of equipment and vehicles which currently operate in the depot.

The only external receptor of noise within proximity of landfill Area 4 is the Austral Bricks sales and display area. The Waste Service has already introduced or agreed to safeguards to control noise levels in this area including:

- ☐ an earthen bund wall along the southern site boundary adjacent to the landfill area;
- ☐ an operational plan which requires a cell wall to be erected on the southern side of operations when levels begin to rise above the bund wall;
- ☐ agreement to erect a temporary acoustical fence on top of the bund wall if monitoring shows this to be necessary;
- ☐ agreement not to work the southern end of Area 4 at weekends if monitoring indicates noise criteria are not being met.

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Extension of depot life will not increase noise levels but will result in noise being generated for a longer period of time.

4.5 GAS AND ODOUR

At the present time landfill gas is not collected at Eastern Creek. The Waste Service has agreed to introduce a collection system if the depot creates an odour problem to users of surrounding land.

The proposal to excavate and remove clay/shale may marginally alter the rate of gas generation by providing a deeper landfill.

The undertaking by the Waste Service to respond to an odour problem by collecting and disposing of landfill gas is considered an adequate safeguard. The effectiveness of this measure will not be reduced by a lengthening of the life of the depot.

It is not feasible to produce contour diagrams which could reliably predict the occurrence or extent of odour episodes from the depot. This is because factors which determine the rate, concentration and location of gas emissions from landfills are not easily quantified (Holmes 1991).

4.6 DUST

As with noise, the nearest receptor for fugitive dust escaping from the Area 4 landfill is the Austral Bricks sales and display area. The proposal to excavate additional clay/shale and remove it from site will have the potential to increase dust generation on the site. Vehicles moving on unsealed roads are the most significant source of windblown dust in a waste depot.

Haulage trucks will be required to approach the excavation area along existing sealed roads provided for waste delivery vehicles. The distance to be travelled on temporary unsealed tracks to the excavation area will be similar to the distance travelled by waste vehicles in reaching the tipping area. The Waste Service will confine haulage vehicles to a single route within the depot and apply dust suppression sprays as are currently used on temporary roads leading to the tipping face.

The Waste Service has already agreed with Austral Bricks to cease work on the southern end of the site in certain strong wind conditions to reduce dust generation. A weather station has

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been installed in the property which is connected to an alarm which operates when the pre-set conditions occur.

Other safeguards to limit dust generation at the depot include:

- ☐ spraying bare earth surfaces with a bitumastic binder if they are to be left unworked for one month or longer;
- ☐ speed controls on unsealed roads within the depot;
- ☐ a commitment to spray bitumastic binder on unsealed roads if monitoring reveals excessive dust concentrations from the depot at Austral Bricks sales area.

Extending depot life will increase the period of time during which implementation of the above safeguards will be required.

4.7 VISUAL CHARACTERISTICS

Excavation and removal of additional clay/shale from the depot will not alter the visual characteristics of the site. Measures have already been implemented to reduce the visibility of the landfill mound and waste disposal operations in Area 4 from the adjoining Austral Bricks sales area.

Included in the mitigation measures are the following:

- ☐ a landscaped earthen bund along part of the southern depot boundary;
- ☐ tree and shrub planting within Austral Bricks property;
- ☐ tree and shrub planting within the waste depot with an irrigation system;
- ☐ erection of green shade cloth on a cyclone boundary fence to provide further visual screening.

The Area 4 landfill is effectively screened by topography and vegetation from all other adjoining properties. Consequently extending the life of the depot will not alter its external visual characteristics.

4.8 LITTER

Extraction and removal of additional clay/shale will not create any additional litter impacts. The Waste Service will ensure that haulage vehicles are loaded within their capacity so that clay shale does not spill from trucks onto public roads.

Litter controls in place at the waste depot include:

- ☐ prompt compaction and covering of waste when it is deposited at the workplace;
- ☐ temporary litter fence near the working area to catch any wind blown litter;
- ☐ litter patrols by depot staff extending along the Wallgrove Road frontage of the depot and adjoining poultry farm to the Austral Bricks access road;
- ☐ implementation of an awareness campaign including signs, handouts and verbal messages to drivers of uncovered loads;
- ☐ litter patrol along the Austral Bricks access road on an agreed frequency after strong northerly winds to remove any litter sourced in the waste depot.

The above controls would be maintained through to closure of the depot, including any extension in life obtained through removal of clay/shale.

4.9 OTHER POTENTIAL IMPACTS

Excavation and removal of additional clay/shale will not significantly affect flora, fauna, archaeology, vermin control, final landform, final landuse, emergency response procedures, flooding of Eastern Creek or property values and will not create any significant social impacts or effects on health and safety or increased risk of bushfire or other hazardous contingency.

Vegetation along Eastern Creek will not be affected by the proposal and an archaeological relic identified on the site will remain fenced off and undisturbed. Controls to scare birds away from the landfill have proven to be effective over a number of years and will continue to be implemented.

The proposal is predicted to result in the waste depot operating for an extra two to three years which will not create any new impacts or intensify existing impacts of waste disposal.

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4.10 ENERGY STATEMENT

Liquid fuels will be consumed in excavating the additional material. Vehicles transporting clay/shale from the site will also consume liquid fuels. However, if Eastern Creek depot were not available as a source of clay/shale, some of the recipients may transport material from further afield, resulting in greater usage of liquid fuels.

Savings in energy will result from extending the life of Eastern Creek waste depot, which is well located to serve western Sydney. Ultimately when readily-accessible sites such as Eastern Creek are filled it will be necessary to incur greater energy usage to transport waste to more remote locations. By deferring the time when such transport is required, the proposal will save energy for the community.

4.11 ENVIRONMENTAL MONITORING

A range of parameters are already monitored at Eastern Creek depot. The Waste Service is developing environmental management plans for all of its waste depots in consultation with local communities. Such plans detail site management, operations and environmental safeguards and specify a procedure for monitoring a range of parameters and reporting the results to the community. The plans also specify revegetation objectives and procedures where relevant.

It is proposed that an environmental management plan of this nature be prepared for Eastern Creek depot. In the interim the Waste Service will continue to monitor meteorology, surface water, groundwater, leachate, dust, noise, odour, litter, traffic and pollution controls. The Waste Service has the demonstrated capacity to manage the environmental consequences of Eastern Creek depot and the proposal to extract and remove additional clay/shale.

5. JUSTIFICATION AND CONCLUSION

Chapter 5

JUSTIFICATION AND CONCLUSION

The proposal is justified because it will extend the life of a solid waste depot which is vital for the efficient disposal of putrescible waste in western Sydney.

The alternative of not proceeding with the proposal would lose forever the opportunity to bury additional waste on the Eastern Creek site. Once the base layer of waste has been fully placed over landfill Area 4 there will be no further opportunity to excavate material. If approval to remove clay/shale is not obtained now, the opportunity will have been lost.

Another possible alternative of extracting clay shale at a lesser rate than proposed would also result in sacrifice of valuable landfill space.

The existing environment is that of an operating waste disposal depot. In this context excavation and removal of additional clay/shale and the consequent extension in depot life will not have a significant environmental impact on the site or its surroundings. The proposal will cause additional truck movements on the main road system, but this will not restore truck numbers to the levels generated by the site during 1991 and earlier years, before restrictions were placed on commercial and industrial waste.

REFERENCES

REFERENCES

DJ Douglas and Partners Pty Ltd (1993)

Report on Hydrogeological Study, Regional Waste Depot, Eastern Creek.

Holmes, N. & Associates, 1991

Air Quality Assessment, Lucas Heights Regional Depot

Minister for the Environment (1992)

Waste Management Green Paper.

Mitchell McCotter & Associates (1989)

Proposed Extension of Eastern Creek Landfill Depot, Review of Environmental Factors.

Mitchell McCotter & Associates (1991)

Extension of Eastern Creek Regional Waste Depot, Environmental Management Plan.

(Considers matters of relevance to Austral Bricks only).

Mitchell McCotter & Associates (1991)

Control of Waste Depot Noise at Austral Bricks, Horsley Park.

APPENDICES

Appendix A

FORM 4 CERTIFICATE

FORM 4

ENVIRONMENTAL PLANNING AND ASSESSMENT ACT, 1979

(SECTION 77 (3) (d))

ENVIRONMENTAL IMPACT STATEMENT

This Statement has been prepared by or on behalf of WASTE RECYCLING AND PROCESSING SERVICE
.....being the applicant
making the development application referred to below.

The Statement accompanies the development application made in respect of the development described as follows:

Extract additional clay shale from Eastern Creek waste depot and remove it from
the site. Continue to operate the depot to fill the void so created up to approved
final contours.

The development application relates to the land described as follows:

No.....Street Wallgrove Road

Locality/Suburb Eastern Creek

Property Real description Lot 1 in DP 778564 and Part Lot Y in DP 376524

(e.g. Lot, D.P./M.P.S., Vol./Fol., Parish, Portion)

The contents of this statement, as required by Clause 34 of the Environmental Planning and Assessment Regulation, 1980, are set forth in the accompanying pages.

Name, Qualifications and Address of person Terry Perram BSc(Eng) MEngSci DipEnvSt.

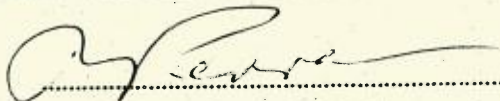
who prepared Environmental Impact Statement Level 1, 24 Falcon Street

CROWS NEST 2065

Certificate

I, Terry Perram of Mitchell McCotter and Associates Pty Ltd

hereby certify that I have prepared the contents of this Statement in accordance with Clauses 34 and 35 of the Environment Planning and Assessment Regulation, 1980.


17/3/93

Appendix B

SUMMARY OF RESPONSES FROM
AUTHORITIES

APPENDIX B

SUMMARY OF RESPONSES FROM AUTHORITIES

A number of public authorities were contacted during the course of preparing the environmental impact statement. Replies received are summarised below and were taken into consideration in preparing this document.

Blacktown City Council

Council indicated that its concerns would be of a general nature, with reference to the following issues:

- ☐ traffic;
- ☐ dust control;
- ☐ effect on the Western Sydney Recreation Area and Eastern Creek Raceway;
- ☐ types of waste to be used to fill the additional void;
- ☐ any effect on Prospect Reservoir.

Department of Conservation and Land Management

Separate replies were received from the Department of Lands and the Soil Conservation Service, which are divisions of CALM.

The Department of Lands expected that the EIS should include:

- ☐ types of waste;
- ☐ control of dust, leachate, stormwater, gas and potential impacts on the area;
- ☐ final contours;
- ☐ restoration and maintenance;
- ☐ end use capability of the land and options plan.

The Soil Conservation Service set out a series of guidelines for erosion and sediment control which have been incorporated in the existing depot operations.

Environment Protection Authority

The Authority requested that particular attention be given in the EIS to the following:

- ☐ soil erosion and sediment control;
- ☐ suppression of excessive dust;

- ☐ impact of increased truck movements on the amenity of the area and on transport corridors.

Department of Health

The Department raised no obligations to the proposal.

Department of Mineral Resources

If the clay/shale is privately owned a mining lease is not required to fill excavated material. [the clay shale is privately owned].

The Department provided advice on the nature of material underlying the depot and indicated the proposal has the potential to make a significant contribution to Sydney's clay/shale requirements. The Department supports the proposal in principle.

Roads and Traffic Authority

The Authority requested the following matters to be addressed in the EIS.

- ☐ traffic demands and the ability of the regional road network to accommodate the demand;
- ☐ consideration of increased road maintenance requirements if traffic generation is high;
- ☐ required improvements to any poor intersection layouts in the vicinity of the site.

Water Board

The Board is concerned with three issues in relation to the proposal:

- ☐ maintaining water quality in Prospect Reservoir. The Board regards the current measures to deter silver gulls from feeding at the depot as an interim solution only to the threat to water quality in Prospect Reservoir. [These measures were introduced in 1987].
- ☐ water quality in the Hawkesbury/Nepean River Systems. The Board is concerned at the impact of soil erosion and leachate on surface water and ground water in the

Eastern Creek Catchment. The impact of creek flooding should be considered;

- ☐ integrity of the water supply pipelines. The Board has set conditions on excavating in the vicinity of the pipelines after conducting a geotechnical investigation. [The conditions have been complied with and the excavation has proceeded].

Department of Water Resources

The Department indicated that it had not special comment or advice on the proposal but suggested that three guideline documents published by the Department be consulted:

- ☐ *"A Guide to Stream Channel Management";*
- ☐ *"The 7-step method of controlling bank erosion and sediment Build-up";*
- ☐ *"General Requirements for Environmental Impact Statements".*

Appendix C

REQUIREMENTS OF THE
DIRECTOR OF PLANNING



Department of Planning

Mr J R Pym
Waste Management Authority
Of New South Wales
PO Box 699
CHATSWOOD NSW 2057

Remington Centre
175 Liverpool Street, Sydney 20
Box 3927 G.P.O. Sydney 2001
DX. 15 Sydney

Telephone : (02) 391 2000 Ext
Fax No : (02) 391 2111

Contact: Alan Bright
2081
Our reference: P91/02027

30 Aug 1991

Your reference: JRP/ML

Dear Mr Pym,

**PROPOSED EXTENSION OF EASTERN CREEK REGIONAL DEPOT,
WALLGROVE ROAD, EASTERN CREEK**

Thank you for your letter of 31 July, 1991 indicating that you are consulting with the Director with regard to the preparation of an environmental impact statement (EIS) for the above development.

2. As development consent is required for the proposal pursuant to State Environmental Planning Policy No.29 - Western Sydney Recreation Area and it is a designated development within the meaning of Schedule 3 of the Environmental Planning and Assessment Regulation, 1980, as amended, an EIS must accompany the development application. The Minister for Planning is the consent authority for the proposal. The EIS shall be prepared in accordance with clause 34 of the Regulation and shall bear a certificate required by clause 26(1)(b) of the Regulation (see Attachment No. 1).

3. In addition, pursuant to clause 35 of the Regulation, the Director requires that the following matters be specifically addressed in the EIS:

Detailed description of the proposal including plans for the extraction of clay shale and a description of the wastes likely to be deposited at the proposed depot. Each waste should be described in terms of-

- quantity, physical form and state,
- geographic source(s),
- recycle potential and suitability for alternative means of disposal,
- the generator(s) of the waste (any individual large quantity generator should be identified),
- chemical composition, reactivity and decomposition products,

- identification of any hazardous, toxic or environmentally damaging properties of the waste, any components or decomposition products,
- parasites, pathogens or other organisms contained therein ,
- any hazardous or toxic materials which would be accepted for deposition at the site must be identified;

water impacts. A detailed hydrological study of the site and assessment of the potential and likely impact of the proposal, particularly the potential for diseases, biologically active material, leachates, toxic or hazardous materials entering groundwater, stormwater, streams and waterways including the Prospect Reservoir. A water management and monitoring plan should be outlined and assessed for its adequacy and effectiveness;

transport and traffic impact of the proposal and an assessment of the adequacy of the local and regional road network to handle associated traffic demands. Any additional road works needed to provide access or cope with increased demands should be described. The routes to be used by waste transporters should be described as should the types and numbers of vehicles;

potential impact of odour, dust, blowing garbage, fly nuisance, cockroaches, bird nuisance, vermin, vibration and noise should be assessed. Control measures and measures proposed in mitigation including program of monitoring should be described. Contour maps showing the extent of odour incidents and the effects of various wind conditions should be included;

wildlife and vegetation, including impact of the proposal on the existing environment;

social impacts, health and safety, particularly in relation to potential for spread of plant, animal and human diseases, and hazards related to combustible gases, bushfires, spills or releases of hazardous materials and any consequential effects on nearby property values;

- . management measures and any plans for rehabilitation. Management measures considered should include analysis and control of wastes accepted, monitoring of environmental conditions, undertaking regular environmental quality audits and reviews of practices. A review, where relevant to the proposal, of the past environmental monitoring and control performance by the proponent at its other sites and an assessment of the proponent's ability to manage the environmental consequences of this proposal;
- . reference to the provisions of Sydney Regional Environmental Plan No. 9 Extractive Industry;
- . assessment of any impact of the proposal on the water quality of the Hawkesbury-Nepean catchment. In this regard, the proposal should be assessed in light of the provisions of Sydney Regional Environmental Plan No. 20 - Hawkesbury-Nepean River;
- . impact of flooding on the proposal;
- . visual impact of the proposal; and
- . results of consultation with:
 - Blacktown City Council,
 - State Pollution Control Commission,
 - Department of Health,
 - Department of Conservation and Land Management,
 - Department of Water Resources,
 - Water Board,
 - Roads and Traffic Authority.
 - Department of Mineral Resources

4. Attachments No. 2a and 2b are guides to the type of information most likely to be relevant to the development you propose. Not all of the matters raised therein may be appropriate for consideration in the EIS for your proposal, equally, the guides are not exhaustive.

5. Should you require any further information regarding this matter please do not hesitate to contact us again.

Yours faithfully,



Peter Hamilton
 Manager
 Assessments Branch
As Delegate for the Director

DEPARTMENT OF PLANNING
ATTACHMENT NO. 1

STATUTORY REQUIREMENTS FOR ENVIRONMENTAL IMPACT STATEMENTS

In accordance with Part IV of the Environmental Planning and Assessment Act, 1979, an environmental impact statement (EIS) must meet the following requirements.

Pursuant to clause 34 of the Environmental Planning and Assessment Regulation, 1980, as amended, the contents of an EIS shall include the following matters:

- (a) full description of the designated development proposed by the development application;
- (b) a statement of the objectives of the proposed designated development;
- (c) a full description of the existing environment likely to be affected by the proposed designated development, if carried out;
- (d) identification and analysis of the likely environmental interactions between the proposed designated development and the environment;
- (e) analysis of the likely environmental impacts or consequences of carrying out the proposed designated development (including implications for use and conservation of energy);
- (f) justification of the proposed designated development in terms of environmental, economic and social considerations;
- (g) measures to be taken in conjunction with the proposed designated development to protect the environment and an assessment of the likely effectiveness of those measures;
- (g1) details of energy requirements of the proposed development and measures to be taken to conserve energy;
- (h) any feasible alternatives to the carrying out of the proposed designated development and reasons for choosing the latter; and
- (i) consequences of not carrying out the proposed development.

The EIS must also take into account any matters required by the Director of Planning pursuant to clause 35 of the Regulation, which may be included in the attached letter.

The EIS must bear a certificate as required by clause 26(1)(b) of the Regulation.

DEPARTMENT OF PLANNING
ATTACHMENT NO 2A

ADVICE ON THE PREPARATION OF AN ENVIRONMENTAL IMPACT
STATEMENT (EIS) FOR AN EXTRACTIVE INDUSTRY

A definition of extractive industry may be found in paragraph (n) to Schedule 3 of the Environmental Planning and Assessment Regulation, 1980, (as amended). These industries are operations undertaken for the purpose of mining sand, gravel, clay, turf, soil, rock, stone or similar substances. The definition of extractive industry specifically excludes coal, petroleum or minerals which are prescribed under the Mining Act, 1973. Extractive industries may take the form of dredging operations, quarrying operations, turf farms or various forms of land excavation etc. Processing of extracted material on the same site as the winning of the material may also constitute an extractive industry.

Extractive industries have prompted considerable public controversy in the past since, among other things, they affect visual amenity, generate heavy vehicle movements, raise dust and cause disturbance through noise and blasting. This is the prime reason for designation of extractive industries under the Environmental Planning and Assessment Act, 1979.

The purpose of this paper is to outline various issues relevant to the preparation and consideration of an EIS for extractive industries. It is intended to assist the preparation of the EIS. However, it is the applicant's responsibility to identify and address as fully as possible the matters relevant to the specific development proposal in complying with the requirements for EIS preparation (see Attachment No 1).

The matters nominated in this paper are not intended as a comprehensive identification of all issues which may arise in respect of an extractive industry. Some of the issues nominated may not be relevant to a specific proposal. On the other hand, there may be other issues, not included, that are appropriate for consideration in the EIS.

Information provided should be clear, succinct and objective and where appropriate be supported by maps, plans, diagrams or other descriptive detail. The purpose of the EIS is to enable members of the public, the consent authority (usually the Council) and the Department of Planning to properly understand the environmental consequences of the proposed development.

1. Description of the proposal.

The description of the proposal should provide general background information on the location and extent of the works proposed, an indication of adjacent developments, and details of the site, land tenure, zonings and relevant forward planning proposals and any other land use constraints.

- . Details of floods and any likely effects of the operation on flood liability of surrounding lands.
- . The possible effects of flooding on the operation.
- . Effects on flora and fauna.
- . The agricultural viability of the landholding.
- . Likely noise/vibration disturbance caused by the operations, including transport operations, on nearby residences.
- . Other impacts of trucking movements, including access over railways and onto highways.
- . Dust nuisance likely to be caused.
- . Effects on water quality of nearby watercourses.
- . Disposal of waste material.
- . Effects on the visual environment.
- . Any likely affectation of sites of Aboriginal archaeological or European heritage value if located in the vicinity of operations.
- . Impact of the operations on navigation aspects for all types of shipping (commercial, recreational, etc).

In addition, any potential for hazard or risks to public safety and any proposals to monitor and reduce environmental impacts should be included.

4. Contact with relevant Government Authorities.

In preparing the EIS, it is suggested that authorities, such as those listed below, should be consulted and their comments taken into account in the EIS.

- . The State Pollution Control Commission in regard to air, water and noise impacts and relevant pollution control legislation requirements;
- . The Department of Minerals and Resources concerning its responsibilities under Sydney REP No 9 Extractive Industry;
- . The Department of Water Resources concerning the implications of the proposal on their jurisdiction;
- . The Soil Conservation Service regarding appropriate erosion control and rehabilitation procedures;
- . The Department of Agriculture if prime agricultural land may be affected by the proposal;
- . The Heritage Council of NSW if the proposal is likely to affect any place or building having heritage significance for the State; the National Parks and Wildlife Service if aboriginal places or relics are likely to be affected.
- . The Maritime Services Board in relation to navigational aspects of shipping; and
- . The Public Works Department in relation to hydrological impacts and relevant legislative requirements.

It is the responsibility of the person preparing the EIS to determine those Departments relevant to the proposed development.

The EIS should address the compatibility of the proposal with any regional strategy for extractive industries in the area and with the provisions of the Local Environmental Plans for existing and proposed development.

This section should provide specific information on the nature, intent and form of the development. It should, as far as possible, include such details as the processes involved (highlighting any proposed crushing or blasting), disposal of wastes, landscaping and site rehabilitation. A description should also be provided of associated operations such as the transport of materials and use of the end product if likely to have environmental implications.

Particular details that may be relevant include:

- . Characteristics and economic significance of the resource.
- . Possible availability of alternative resources.
- . Quantity of materials to be extracted.
- . Details of any blasting and/or crushing.
- . Effects of vibrations.
- . Type of machinery and equipment to be used for dredging and stockpiling operations and for any processing plant.
- . Expected life of the operation.
- . Hours of operation.
- . Details of necessary stockpiling.
- . Access arrangements - truck routes, truck numbers etc.
- . Site drainage and erosion controls.
- . Proposals for rehabilitation.

2. Description of the Environment.

This should provide details of the environment in the vicinity of the development site and also of aspects of the environment likely to be affected by any facet of the proposal. In this regard, physical, natural, social, archaeological and economic aspects of the environment should be described to the extent necessary for assessment of the environmental impact of the proposed development.

3. Analysis of Environmental Impacts.

Environmental impacts usually associated with extractive industries are listed below. Where relevant to the specific proposal, these should be addressed in the EIS, taking into account the adequacy of safeguards proposed to minimise them.

- . The flow of any affected rivers or watercourses.
- . The effect of the extraction on the sediment transport rate of any affected rivers or watercourses.
- . The bed and bank stability of any affected rivers during and after completion of the operations and any need for recurrent maintenance dredging.
- . Any possible siltation, sedimentation or downstream effects of the operation.
- . Any likely cumulative effects of the proposed operation when considered together with other operations in the vicinity.

DEPARTMENT OF PLANNING
ATTACHMENT NO 2B

ADVICE ON THE PREPARATION OF AN ENVIRONMENTAL IMPACT
STATEMENT (EIS) FOR A SANITARY LANDFILL WASTE DISPOSAL
OPERATION.

The purpose of this paper is to outline various issues relevant to the preparation and consideration of an EIS for sanitary landfill operation. It is intended to assist the preparation of the EIS. However, it is the applicant's responsibility to identify and address as fully as possible the matters relevant to the specific development proposal in complying with the requirements for EIS preparation (see Attachment No 1).

The matters nominated in this paper are not intended as a comprehensive identification of all issues which may arise in respect of a sanitary landfill operation. Some of the issues nominated may not be relevant to a specific proposal. On the other hand, there may be other issues, not included, that are appropriate for consideration in the EIS.

Information provided should be clear, succinct and objective and where appropriate be supported by maps, plans, diagrams or other descriptive detail. The purpose of the EIS is to enable members of the public, the consent authority (usually the Council) and the Department of Planning to properly understand the environmental consequences of the proposed development.

The following particular matters shall also be included in the EIS:

1. Background information.

- . Location of the operations and indication of adjacent developments.
- . Broad nature and extent of operations proposed.
- . Land tenure, boundaries, site details in relation to environmental planning instrument zonings and any other land use constraints.
- . Site selection process: location, topography, ecological values, climate, hydrology, geology.

2. Detailed description of the proposal.

This description shall not only describe the proposal at the site but also describe any associated operations such as winning and transport of cover materials, rehabilitation.

Particular matters to be covered include:

- . Site preparation.
- . Method of filling.
- . Source of cover materials.
- . Plans of operations, sequence of areas, lifts, segregation of wastes.
- . Final contours of the site.
- . Type of machinery and equipment to be used.
- . Expected life of the operation.
- . Number of persons to be employed.
- . Hours of operation.
- . Access arrangements - truck routes and number of truck movements.
- . Quantity of cover materials and topsoil to be extracted/placed.
- . Noise levels.
- . Site drainage and erosion controls.
- . Proposals for landscaping and site rehabilitation.
- . Daily operational plan.
- . Resources recovering requirements.

3. Description of the environment.

This description shall provide details of the environment in the vicinity of the development site and also of aspects of the environment likely to be affected by any facets of the proposal. In this regard, physical, natural, social, archaeological and economic aspects of the environment should be described to the extent necessary for assessment of the environmental impact of the proposed development.

4. Assessment of environmental impact and measures to be taken to reduce the impact especially with respect to:-

- . Water pollution controls, surface and groundwaters, monitoring measures.
- . Likely noise disturbance caused by the operations, including transport operations, on nearby residences.
- . Other impacts of trucking movements.
- . Dust control and any nuisance likely to be caused.
- . Gas movement, odour, fire control measures, monitoring measures.
- . Treatment and disposal of leachates.
- . Litter controls and site maintenance.
- . Landscaping measures and effects on the visual environment.
- . The proposed final use of the site and maintenance of completed landfill site.
- . Any likely affectation of sites of aboriginal archaeological or heritage value if located in the vicinity of the operations.

5. Authorities contacted.

The names of authorities contacted should be listed. Any comments relating to specific matters of interest raised by such authorities should be declared.

The State Pollution Control Commission should be consulted and its Guideline WD-2 should be referred to in preparing the EIS.

Appendix D

EXCLUDED WASTE

APPENDIX D EXCLUDED WASTE

The substances listed below are a guide to the types of materials currently excluded from landfill waste disposal sites by the Environment Protection Authority.

1. Liquid wastes
2. Radioactive wastes.
3. Any flammable liquid or material derived from grease, oil, tar petroleum, shale or coal.
4. Any sludge or material (unless it can be shown to be innocuous and harmless) being the refuse from any industrial process carried on in:
 - i. any tanning or leather processing plant
 - ii. any petroleum or petrochemical plant
 - iii. any chemical plant
 - iv. any paint manufacturing plant
 - v. any metal treatment plant
 - vi. any vegetable oil or mineral oil plant
 - vii. any pharmaceutical or drug manufacturing plant
5. Any material containing arsenic, cyanide or sulphide.
6. Any toxic soluble salt of the following:

Barium	Copper	Selenium
Boron	Lead	Silver
Cadmium	Manganese	Zinc
Chromium	Mercury	
7. Any pesticide or weedicide - in particular any:
 - Chlorinated hydrocarbons
 - Fluorinated hydrocarbons
 - Organophosphates
 - Carbamates
 - Phenols

8. Any soluble acid or alkali or acidic or basic compounds.

The Environment Protection Authority has requirements for leaching tests to be carried out on substances where the acceptability for landfilling is not clear in accordance with the above guidelines.

Appendix E

HYDROGEOLOGICAL STUDY



**REPORT
ON
HYDROGEOLOGICAL STUDY**

**REGIONAL WASTE DEPOT
EASTERN CREEK**

prepared for
**WASTE RECYCLING & PROCESSING
SERVICE**

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REPORT ON HYDROGEOLOGICAL STUDY REGIONAL WASTE DEPOT EASTERN CREEK

1. INTRODUCTION

This report describes the results of a limited hydrogeological study carried out at the Regional Waste Depot at Eastern Creek. The work was requested by Mr John Pym of the Waste Recycling and Processing Service (WRAPS) for inclusion in an Environmental Impact Statement (EIS) being prepared by Mitchell McCotter & Associates Pty Ltd, Planning, Environmental and Engineering Consultants for the proposed extraction of clay from the Depot.

The area covered by the study is adjacent to Eastern Creek and is presently used for the disposal of industrial and domestic waste. Owing to the proximity of the site to a major drainage channel, the study was undertaken to:

- . gain basic understanding of the soil lithology;
- . determine the degree of weathering of the bedrock;
- . assess the hydraulic conductivity of the rock;
- . compile a basic hydrogeological model in regards to groundwater flow direction and velocity;
- . sample and test the groundwater for chemical contaminants.

The study comprised:

- . drilling and sampling of the soil and rock;
- . installation of standpipe piezometers;
- . pump recovery tests in the standpipe piezometers;
- . sampling of the groundwater and chemical analysis;
- . review of all the relevant data, including chemical test results provided by WRAPS.

This report summarises the results of all facets of the study. It also gives a preliminary assessment of the groundwater flow and the possibility of contamination of the groundwater by waste disposal.

2. SITE DESCRIPTION

The site is an open, irregular shaped area measuring about 1000 m in an east-westerly direction and approximately 400 m in a north-south direction. It is located on the eastern side of Wallgrove Road, two kilometres south of the intersection with the Western Freeway (Drawing 14875/1). The site has been used for disposal of waste for many years and, as such, the surface levels have changed appreciably. However, the surrounding countryside is gently undulating at slopes estimated to be up to 2 - 5%; this gives some idea of the natural slopes which would have existed prior to the site being developed.

3. REGIONAL GEOLOGY

The Penrith 1:100,000 Series Geological Sheet indicates that the site is underlain by Bringelly Shale, which is part of the Wianamatta Group of Triassic Age. The Wianamatta Group consists of three formations of which the Bringelly Shale is stratigraphically the highest. In the area west of Sydney, the sedimentary rocks have been gently folded to form a basin-like structure with the Bringelly Shale generally occupying the centre.

The Bringelly Shale consists of claystones and siltstones, laminite and sandstone units with minor occurrences of coal, carbonaceous claystone and tuff (Geol Survey, 1980). The various units are typically dark grey or black but also include light grey claystone units, caused by leaching.

4. HYDROGEOLOGY

4.1 Groundwater Quality

The notes accompanying the Penrith 1:100,000 Series Geological Sheet indicates that there are not many registered bores in the Wianamatta Group rocks, probably because the relatively high salinity of the water has made it unsuitable for use. Old (1942) reports total salt concentrations of up to 31,750 mg/litre in water taken from the Bringelly Shale and indicates that 51% of the 428 water samples taken from 1894 to 1942 had total dissolved solids of greater than 11,400 mg/litre. The clear indication from the above is that natural groundwater within the Bringelly Shale has a relatively high salinity, and would therefore be unsuitable for agricultural or domestic use.

4.2 Groundwater Yield

The Bringelly Shale has a weathered mantle which is essentially clay for which a low primary hydraulic conductivity would be expected. Beneath the weathered mantle, the relatively fresh bedrock is variably fragmented to slightly fractured. In this bedrock zone, the primary hydraulic conductivity of the rock is extremely low and in the absence of defects or jointing, water transmissivity will be negligible. Nevertheless, quite high flows may occur through fractures, joints and bedding defects. Intrusive features such as dykes or sills, which are commonly associated with localised fracture zones, may also lead to substantial flows.

4.3 Groundwater Levels

The piezometric surface in the Bringelly Shale at Eastern Creek would be expected to be a subdued reflection of the surface topography, at least the topography which existed prior to quarrying and filling. Local perched water tables may occur in the clay mantle but these will depend largely on prevailing weather conditions. Piezometric levels in the bedrock should change slowly with time as the highly impermeable clay cover should result in most rainfall being directed to surface runoff rather than into the groundwater system.

5. FIELDWORK AND OBSERVATIONS

5.1 Observations

Observations made on the site during and after the test drilling confirmed the general stratigraphic sequence expected for the Bringelly Shale. Within the waste pit near the eastern boundary, about 3 - 4 m of clay were seen to overlie fractured shale which continued to the full depth of excavation estimated to be up to 6 m maximum.

One significant feature (from a geological and hydrogeological point of view) was the existence of a narrow (about 500 - 700 mm), near vertical band of yellow and white/light grey sandy clay within the dark grey shale (see Photos 1, 2, 3 and 4 in Appendix B). This material has been identified as being of igneous origin, probably part of an intrusion (dyke). There is no indication of dykes in the published data (i.e. the geological map) but significant intrusions have been extensively mined locally at Prospect so the presence of dykes within the region is not uncommon.

The dyke (which trends 052°MN) consists of relatively unjointed, extremely to highly weathered dolerite with sandstone/clay clasts within this material. The margins of the dyke have been extensively altered over about 0.5 m width.

5.2 Drilling

5.2.1 Procedures

The field investigation was undertaken in two stages as follows:

- Five vertical bores (B1 to B5) to sample the bedrock and to install standpipe piezometers for groundwater sampling.
- Two angled bores (B6 and B7) through the dyke to assess the hydraulic conductivity of the dyke and surrounding material and to sample groundwater.

The locations of all the bores are shown on Drawing 14875/2 in Appendix A.

The bores were drilled using a truck-mounted auger/rotary drilling rig, drilling with spiral flight augers or non core bits in the overburden soil and NMLC coring equipment in the underlying bedrock. Undisturbed and disturbed samples were taken of the clay profile at regular depth intervals to assist in identification

purposes. Core drilling commenced upon reaching the surface of the bedrock and in the case of the vertical bores continued to a total depth of 15 m.

The angled bores were drilled approximately perpendicular to the dyke at angles of 45° to the horizontal and were positioned to intersect the dyke about 5 m below the clay/shale interface.

5.2.2 Results

The detailed results of the site drilling are given in Appendix B on the test bore report sheets. These results are accompanied by notes which define the terms used to classify the clay and bedrock strata and photographs of the dyke.

The vertical bores encountered a stratigraphic sequence which is summarised in Table 1 below.

TABLE 1
GENERALISED STRATIGRAPHIC SEQUENCE

Description	Approximate depth to Layer Interface (m)
Silty clay/clayey silt/shale filling	Surface Level
Very low to low strength siltstone and shale, moderately weathered and highly fractured	3.2 - 4.85
Medium strength and high strength, fresh slightly fractured siltstone and shale	6.4 - 7.2
	15.0

The angled bores encountered clay to depths of 5.2 m and 5.8 m where low strength siltstone was intersected. The dyke consisting of low strength weathered and slightly fractured light grey dolerite was intersected at depths of 12 m and 15 m respectively in Bores 6 and 7. The vertical, 0.85 m wide dyke

was surrounded on either side by a contact metamorphosed zone up to 0.5 m wide.

Plates 1, 2, 3 and 4 in Appendix B show photographs of the dyke in the south-western wall of the pit which had been excavated near the Warragamba water supply pipeline at the time of the original drilling. Plate 1 illustrates quite clearly that the dyke does not penetrate through the surficial clay. It should also be noted that there is a distinct but narrow metamorphosed zone each side of the dyke (Plates 2, 3 and 4) extended for the full depth exposed in the pit wall.

5.3 Groundwater Levels

The depths to groundwater and reduced levels on the piezometric surface at the vertical boreholes drilled during this study are given in Table 2.

TABLE 2
GROUNDWATER LEVELS AND BOREHOLE DATA

Bore No.	Northing* (m)	Easting* (m)	Standpipe RL ** # (m)	Ground Level# (m)	Water Depth on 2.9.92 (m)	Groundwater Level# on 2.9.92 (m)	Water Depth on 18.11.92 (m)	Groundwater Level# on 18.11.92 (m)
1	1256606	287013	52.10	51.00	3.83	48.27	3.62	48.48
2	1256224	286921	59.29	59.01	8.70	50.59	10.90	48.39
3	1256836	286487	50.99	50.65	5.78	45.21	2.04	48.95
4	1257199	286575	48.87	48.54	1.76	47.11	1.67	47.20
5	1257142	286913	49.83	49.32	4.35	45.48	3.62	46.21

* ISG Coordinates

** Level of top of casing

Australian Height Datum

It should be noted firstly that the initial groundwater levels were recorded on the 2 September, 1992, approximately three weeks after the completion of drilling, allowing sufficient time for them to stabilise from those induced by the use of water as a drilling fluid. Further it should be noted that measured water levels in fractured rock systems reflect the piezometric pressure in fractures which have been intersected by the particular borehole. If several fracture systems with differing pressures are intersected, the piezometric pressure would be intermediate between the individual pressures.

The results of groundwater level determinations are inconclusive and there is insufficient information available to determine the direction of groundwater flow with any certainty. There does, however, appear to be a general gradient in a northerly direction towards Reedy Creek and easterly towards Eastern Creek, although the gradients are very flat. Further investigation drilling would be required to better establish the apparent trends in groundwater gradients.

5.4 Pump Recovery Tests

The hydraulic characteristics of the shale were determined firstly by carrying out small scale pump tests within each of the five vertical test bores. In this test, water was removed from the bore at a measured flow rate using a Grundfos submersible pump. The pumping phase took only 10 minutes due to the low transmissivity of the aquifer so it was not possible to reliably establish the discharge versus time relationship.

Recording of the recovery in groundwater level took place using a combination of dip meter measurements and battery operated data loggers set to take readings at five minute intervals for up to five days after purging of the bores.

The results of the pump tests are given in Appendix C and the analytical results are shown in Table 3.

TABLE 3
SUMMARY OF PUMP RECOVERY TEST ANALYSES

Bore No	Transmissivity (m ² /d)	Hydraulic Conductivity	
		(m/d)	(m/s)
1	0.10	0.01	1.2 × 10 ⁻⁷
2	2.1	0.16	1.9 × 10 ⁻⁶
3	0.54	0.05	5.8 × 10 ⁻⁷
4	0.045	0.0045	5.2 × 10 ⁻⁸
5	2.15	0.22	2.5 × 10 ⁻⁶
	0.052	0.0052	6.0 × 10 ⁻⁸

The results indicate that the shale and siltstone is of low permeability (hydraulic conductivity) (US Dept of Interior, 1981) with values ranging from 2×10^{-6} m/sec to 6×10^{-8} m/sec. This indicates that the joints and bedding defects in the shale and siltstone are either generally tight or clay filled, thus preventing significant groundwater flow.

5.5 Packer Testing

Double packer tests were performed within the two angled bores to assess the hydraulic conductivity of the dyke and surrounding materials. The packers were set 1 m apart and tests were performed by inflating the packers to 2000 kPa to seal the test section and pumping water into the hole at pressures of 40, 70 and 100 kPa whilst simultaneously measuring the water flow rate.

The results of the packer tests are shown in Table 4.

**TABLE 4
RESULTS OF PACKER TESTS**

Bore	Depth Interval (m)	Permeability (Lugeons)	Hydraulic Conductivity (m/s)
6	16.6 - 17.6	14	1.4×10^{-6}
	17.6 - 18.6	2	2×10^{-7}
	20.6 - 21.6	6	6×10^{-7}
7	20.15 - 21.15	<1	$<1 \times 10^{-7}$
	21.45 - 22.45	5	5×10^{-7}
	22.55 - 23.55	12	1.2×10^{-6}
	23.6 - 24.6	18	1.8×10^{-6}

These results indicate that both the host rock and the intruded dyke material is of low permeability with values of hydraulic conductivity in the range of 1.8×10^{-6} m/sec to less than 1×10^{-7} m/sec, these values being consistent with pump test results.

5.6 Water Sampling

Water samples to determine the chemical characteristics of the groundwater were taken from each of the vertical bores at the same time as the pump tests were performed. Whilst these samples and those from the angled bores were being collected, in situ determinations were made on conductivity and temperature (and Eh and pH in the vertical bores) over periods ranging from 5 - 10 minutes which was sufficient to obtain stable results. The results of the in situ analyses are given in the Table 5.

TABLE 5
IN SITU MEASUREMENT OF GROUNDWATER PARAMETERS

Bore No	pH	Temperature (°C)	Conductivity (mS/m)	Eh (mV)
1	7.3	18.2	1440	-72
2	7.2	20.0	1070	58
3	7.6	20.1	1210	93
4	8.48	18.8	1580	133
5	8.13	20.4	815	59
6	-	18.4	1567	-
7	-	18.6	1434	-

Water samples were placed in sterilised glass bottles with rubber stoppers and stored in an ice filled container for transport to the testing laboratory. Samples were delivered the same day as testing. Standard Chain of Custody procedures were followed.

Water samples were also taken from each of the angled bores to determine whether the dyke may be a preferential drainage path for leachate from the waste pits.

6. LABORATORY TESTING OF GROUNDWATER

One sample of the groundwater taken from each of the five vertical bores was tested in WRAPS chemical laboratory at the Aqueous Waste Treatment Plant at

Lidcombe for a limited suite of chemical constituents. The results of the analyses are given in Table 6 with the limits, where appropriate, on discharge to streams or rivers as designated by the Clean Waters Act.

The bores were initially purged to remove any water used in the drilling process. Some bores recovered from the purging very slowly and consequently only a limited volume of water was available for chemical testing. Hence, some tests could not be performed on the initial five samples.

Upon completion of the two angled bores, the holes were purged and water samples taken after a suitable period elapsed for recovery. The results of these tests are also included in Table 6.

TABLE 6
RESULTS OF GROUNDWATER CHEMICAL ANALYSIS

PARAMETER	VERTICAL BORES						ANGLED BORES	
	BORE 1	BORE 2	BORE 3	BORE 4	BORE 5	LIMITS#	BORE 6	BORE 7
Conductivity (mS/m)	1670	1200	1760	2030	890			
COD	263	172	241	358	119			
pH	7.3	7.2	7.3	7.1	8.3		6.6	6.8
BOD5		Composite < 2					<5	5
Colour at 100 dilutions	N.D.	N.D.	N.D.	N.D.	N.D.			
Suspended Solids	20	5	8	11	3			
Total Dissolved Solids	I.S.	I.S.	I.S.	I.S.	I.S.			
TOC							4	7
Aluminium (Al)	0.6	1	1	1.3	0.8			
Ammonia (NH4)	2.6	1.1	2.9	3.4	1.1	0.5	0.6	0.7
Arsenic (As)	<0.01	<0.01	<0.01	<0.01	<0.01	0.05		
Barium (Ba)	5.6	0.34	0.4	4.85	0.51	1		
Boron (B)	0.02	0.02	<0.01	0.01	<0.01	1		
Cadmium (Cd)	<0.01	<0.01	<0.01	<0.01	<0.01	0.01		
Chromium (Cr)	<0.01	<0.01	<0.01	0.02	<0.01	0.05		
Cobalt (Co)	0.01	<0.01	0.04	0.02	0.02			
Copper (Cu)	<0.02	<0.02	0.04	<0.02	<0.02	1		
Iron (Fe)	2.44	0.53	0.54	0.77	0.37	0.3		
Lead (Pb)	<0.1	<0.1	<0.1	<0.1	<0.1	0.05		
Manganese (Mn)	0.53	1.5	0.62	1.03	0.27	0.05		
Mercury (Hg)	<0.001	<0.001	<0.001	<0.001	<0.001	0.001		
Molybdenum (Mo)	<0.05	<0.05	<0.05	<0.05	<0.05			
Nickel (Ni)	0.03	0.04	<0.01	<0.01	<0.01			
Selenium (Se)	<0.01	<0.01	<0.01	<0.01	<0.01	0.01		
Silver (Ag)	<0.05	<0.05	<0.05	<0.05	<0.05			
Tin (Sn)	<0.1	<0.1	<0.1	<0.1	<0.1			
Zinc (Zn)	<0.01	<0.01	<0.01	<0.01	<0.01	5		
Sulphate (SO4)	36	320	380	21	205	250		
Sulphide	<0.05	<0.05	<0.05	<0.05	<0.05			
Sulphite + Thiosulphate	<0.5	<0.5	<0.5	<0.5	<0.5			
Chlorinated H'carbons	<0.01	<0.01	<0.01	<0.01	<0.01			
Cyanide - Total (CN)	<0.05	<0.05	<0.05	<0.05	<0.05	0.05		
Formaldehyde (HCHO)	<0.1	<0.1	<0.1	<0.1	<0.1			
Grease (C16-C18)	I.S.	I.S.	I.S.	I.S.	I.S.			
Herbicides	<0.02	I.S.	I.S.	<0.02	I.S.	0.1		
Mercaptans	<0.02	<0.02	<0.02	<0.02	<0.02			
Pentachlorophenol	<0.02	<0.02	<0.02	<0.02	<0.02			
Organochlorides	<0.001	<0.001	<0.001	<0.001	<0.001	0.001		
Organophosphates	<0.01	<0.01	<0.01	<0.01	<0.01	0.05		
Petroleum Hydrocarbon	<0.02	<0.02	<0.02	<0.02	<0.02			
Phenol	<0.03	<0.03	<0.03	<0.03	<0.03	0.001		
PAH	<0.02	I.S.	I.S.	<0.02	I.S.			

N.D. = Not Detected
Clean Water Act

I.S. = Insufficient Sample

Above Limits

7. SURFACE WATER QUALITY

As part of the ongoing monitoring of the operations of the Depot, WRAPS have been collecting regular surface water samples for chemical analysis since 1984 in Reedy Creek at Wallgrove Road (upstream of the Depot) and at the downstream boundary. Reedy Creek flows through the older area of the site between two mounds of filling which are capped with clay about 10 - 15 m above creek level.

Sampling has generally been carried out on a monthly basis although, at times of zero flow in the creek, the stagnant water has not been sampled and tested.

The most recent data available for the surface water sampling is for October 1992. Results for the previous 12 months are given in Table 7.

TABLE 7
RESULTS OF SURFACE WATER SAMPLING

Upstream of Depot													
PARAMETER	Nov-91	Dec-91	Jan-92	Feb-92	Mar-92	Apr-92	May-92	Jun-92	Jul-92	Aug-92	Sep-92	Oct-92	
	7.4	7.1	7.4	7	7.5	7.3	8	7.3	LOW FLOW NOT SAMPLED				7.8
BOD-5	9	8	<5	<5	<5	<5	7	<5					13
COD	60	<5	<5	60	<5	25	300	75					135
TDS	1550	1070	1135	475	620	765	630	1080					1240
TOC	12	27	14	15	13	17	9	22					39
Susp Solids	9	75	30	145	45	26	23	6					25
Ammonia	1.5	25	<1	<1	<1	4.9	<1	18					18
Chloride	625	305	425	135	190	370	290	480					505
Filterable Fe	<0.3	<0.3	<0.3	2	0.8	<0.3	<0.3	<0.3					1.2
Total Fe	1.4	1.4	1.1	8.3	6.7	0.7	1.3	0.8					1.6
	Downstream of Depot												
	Nov-91	Dec-91	Jan-92	Feb-92	Mar-92	Apr-92	May-92	Jun-92	Jul-92	Aug-92	Sep-92	Oct-92	
pH	7.6	6.7	7.8	7.8	7.8	7.4	7.1	7	7.2	7.3	7.4	7.1	
BOD-5	11	5	<5	<5	<5	<5	8	<5	<5	<5	<5	<5	
COD	<10	<5	<5	85	<5	<5	390	<5	40	<5	<5	<5	
TDS	285	800	695	500	560	510	500	265	655	365	210	250	
TOC	11	22	12	18	13	10	8	5	11	7	5	8	
Susp Solids	8	135	40	190	80	22	70	16	17	18	16	90	
Ammonia	<1	11.2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
Chloride	70	225	240	150	170	225	225	75	270	110	50	75	
Filterable Fe	0.4	<0.3	<0.3	2.4	<0.3	<0.3	<0.3	0.5	<0.3	<0.3	<0.3	1.1	
Total Fe	0.9	3.6	1.4	9.6	4.7	0.8	3.7	1.6	1.3	0.8	1.1	3.8	

8. OVERVIEW OF SITE HYDROGEOLOGY

This limited study has given some basic information on the hydrogeology of the site which could be confirmed by further sampling and monitoring of the piezometers installed. In general terms, the study has found that:

- the site is underlain by 3 - 5 m of clay over shale and siltstone;
- there is a dyke in the eastern wall of one of the now filled waste pits trending approximately north-east towards Eastern Creek;
- the hydraulic conductivity of the shale/siltstone is low to very low;
- the groundwater chemistry consistent with uncontaminated water in the Bringelly Shale;
- there appears to be a low potential for leachate movement.

Further comments on these aspects of the study are given below.

8.1 Geology

The geology of the site is straightforward with clay to depths of 3 - 5 m overlying interbedded shales and siltstones. The siltstone/shale is fractured to depths of about 7 - 10 m, below which it is generally slightly fractured. The surface of the shale appears to dip in a northerly direction at a gradient of about 1%.

The presence of a narrow dyke in the north-eastern and south-western walls of an excavation near the southern boundary of the site may have a slight effect on the passage of leachate from within the waste pit. Dykes can be conduits for transmission of groundwater, particularly when the basalt/dolerite material forming the dyke is unweathered, fractured, or when localised fracturing of the host rock has occurred during dyke emplacement. On the other hand, they may form a barrier to lateral flow, particularly where the dyke margins are weathered and clayey.

In this case the dyke is narrow (about 0.7 m to 0.85 m wide, see photos 1, 2, 3 and 4), appears to comprise mostly unfractured, weathered dolerite and the margins are similarly slightly fractured. Moreover, packer tests indicate that both the siltstone and the intruded dyke material are of low permeability. It is considered that the presence of the dyke should not significantly affect the water transmission characteristics of the bedrock.

8.2 Groundwater Levels and Flow Direction

The groundwater levels determined from the five bores indicate that the groundwater is probably flowing in a northerly direction generally towards the confluence of Reedy and Eastern Creeks. It must, however, be emphasised that this conclusion is based on five widely spaced bores and is therefore tentative only. Moreover, the gradients are very flat and small changes due to rainfall could imply reversal of flows.

8.3 Hydraulic Characteristics

The pump tests and packer tests indicate that the transmissivity of the shale/siltstone is low to very low. Accordingly, it would be expected that flow velocities within the bedrock would be very low.

The hydraulic gradients at the site are tentatively calculated as being of the order of 0.5 - 1%, although this figure has been ascertained from water levels in only five bores. Nevertheless, when a value of 1% is combined with the estimated hydraulic conductivities of 10^{-6} to 10^{-7} m/sec, Darcian velocities of 10^{-8} to 10^{-9} m/sec result. Even in slightly fractured rock where effective porosities may be as low as 0.1%, the actual flow velocities would still probably be less than 10^{-5} m/sec or about 1 m per day.

8.4 Groundwater Surface Water Chemistry

The surface water chemistry from results provided by WRAPS indicates ammonia concentrations are similar for water entering (0 - 25 mg/l) and leaving (0 - 11 mg/l) the site. The significance of these results is that ammonia is present in surface water in the region and presumably also in the groundwater by virtue of infiltration.

Ammonia concentrations of between 0.3 and 3.4 mg/l in the groundwater in the seven bores were well below the maximum levels recorded in the surface water upstream of the site. It is concluded that concentrations of the order found in the groundwater are background levels and are not indicative of leachate penetration into the groundwater aquifer.

Further evidence for this conclusion may be found by studying the ammonia concentrations for Bores 2 and 5. Bore 2 ($\text{NH}_4 = 1.1$ mg/l) has a surface elevation

well above the level of most areas of the depot and a water level above the remainder of the bores. The water therefore would almost certainly be uncontaminated. Furthermore, B5 ($\text{NH}_4 = 1.1 \text{ mg/l}$ also) is immediately between a large mound of waste and Eastern Creek and would definitely be affected by leachate flow if it were occurring. The fact that both results are similar indicates that ammonia is a naturally occurring phenomenon in the region.

Barium concentrations are above limits set by the Clean Water Act. These results are considered to be caused by naturally occurring barite in the rock. Similarly, iron sulphate and manganese are natural phenomena in shale.

The absence of heavy metals within the groundwater (i.e. they were mostly below detection limits) indicated either that leachate is not penetrating into the aquifer or that cations are being adsorbed onto clay minerals within the shale. In either case, no migration of heavy metals appears to be occurring.

The one feature of the groundwater chemistry which is of interest is the very high electrical conductivities recorded during both in situ testing and in samples submitted for laboratory analyses. These results are explained by the very high salinity known to exist naturally within the Bringelly Shale. Old (1942) reported chloride concentrations of up to 22,000 mg/litre with values in the Blacktown/Bringelly area being around 6000 - 8000 mg/litre. Enquiries to the Department of Water Resources (McKibbin, personal communication) indicated that little information is available on water quality from within the Bringelly Shale because it is rarely used due to its high salinity. However, typical values of chloride concentration of about 7000 mg/litre are reported.

It is concluded that the high electrical conductivities recorded are due entirely to the natural residual salt concentrations caused by the marine depositional environment of the shale. As a result the groundwater cannot be used for either irrigation or human or animal consumption.

8. CONCLUSIONS

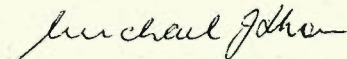
The conclusions drawn from the study are that the site is underlain by rock which has a low/very low transmissivity and flow velocities through the rock would probably be low.

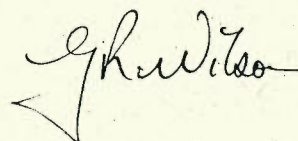
The low concentrations of the measured chemical constituents normally associated with leachate within the groundwater, indicates that the existing depot is not impacting on the groundwater quality. There is no indication of leachate entering the groundwater system.

The study has been based upon seven widely spaced bores and, as such, should be considered as only a limited evaluation of the hydrogeology of the site. Further work would be required to completely characterise the local hydrogeology but this is considered to be unnecessary given that the groundwater cannot be used for either agricultural or consumption purposes and that there appears to be no leachate moving from the existing landfills.

D J DOUGLAS & PARTNERS PTY LTD

Reviewed by:


MICHAEL J THOM.



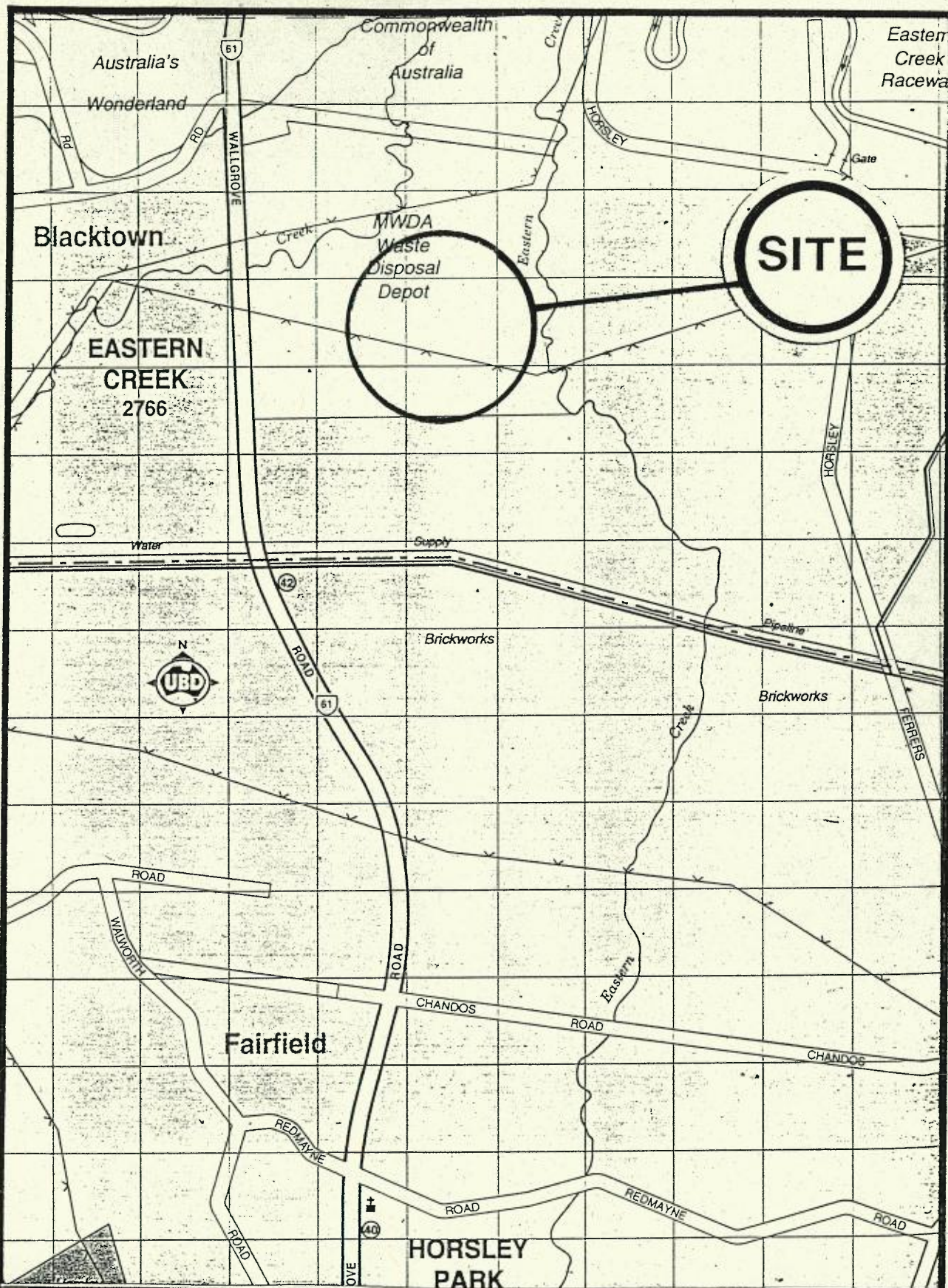
G R Wilson
Senior Engineering Geologist

REFERENCES

1. Geol Survey (1979), "The geology and resource potential of the Wianamatta Group".
2. Geol Survey (1991), "Geology of the Penrith 1:100,000 Sheet".
- 3.. OLD, A.N. (1942), "The Wianamatta Shale Waters of the Sydney District - Their Salinity and a suggested geological explanation", The Agricultural Gazette.
4. US Dept of Interior (1981), "Groundwater Manual".

APPENDIX A

SITE PLANS



D.J. DOUGLAS & PARTNERS PTY. LTD. Geotechnical Consultants
 Sydney Melbourne Brisbane Newcastle Townsville Tuggerah Singleton Gold Coast

TITLE: Locality Plan

Hydrogeological Study EASTERN CREEK

CLIENT: WRAPS

DRAWN BY: —

SCALE: —

PROJECT No: 14 875

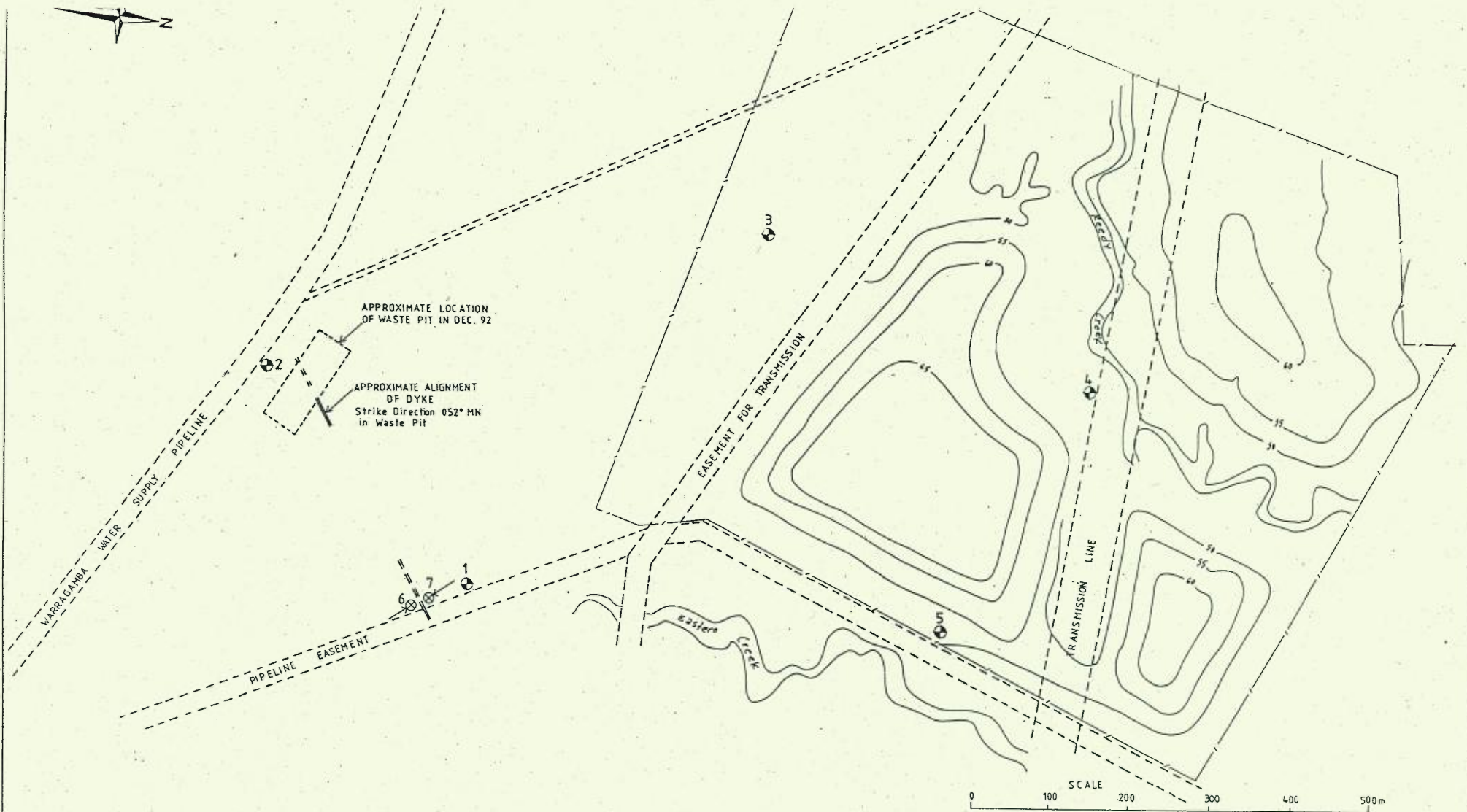
OFFICE:

APPROVED BY:


DATE: 14 12 1992

DRAWING No: 1

SYDNEY



- LEGEND**
- TEST BORE
 - ANGLE TEST BORE
 - DOLERITE DYKE

**D.J. DOUGLAS & PARTNERS PTY. LTD.**
Geotechnical Consultants
Sydney Melbourne Brisbane Newcastle Townsville Tuggerah Singleton Gold Coast

TITLE:
Location of Test Bores
Hydrogeological Study
EASTERN CREEK

CLIENT: WRAPS		PROJECT No: 875
DRAWN BY: P.SCH.	SCALE: As shown	DRAWING No: 2
APPROVED BY:	DATE: 14.12.1992	OFFICE: SYDNEY

APPENDIX B

RESULTS OF TEST BORES
and
PHOTOGRAPHS OF DYKE



NOTES RELATING TO THIS REPORT

Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all of course, are necessarily relevant to all reports.

Geotechnical reports are based on information gained from limited subsurface test boring and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, the S.A.A. Site Investigation Code. In general, descriptions cover the following properties — strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00 mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Undrained Shear Strength kPa
Very soft	less than 12
Soft	12—25
Firm	25—50
Stiff	50—100
Very stiff	100—200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT) as below:

Relative Density	SPT "N" Value (blows/300 mm)	CPT Cone Value (q_c — MPa)
Very loose	less than 5	less than 2
Loose	5—10	2—5
Medium dense	10—30	5—15
Dense	30—50	15—25
Very dense	greater than 50	greater than 25

Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing with a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling are given in the report.

Drilling Methods.

The following is a brief summary of drilling methods currently adopted by the Company and some comments on their use and application.

Test Pits — these are excavated with a backhoe or a tracked excavator, allowing close examination of the in-situ soils if it is safe to descend into the pit. The depth of penetration is limited to about 3 m for a backhoe and up to 6 m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (e.g. Pengo) — the hole is advanced by a rotating plate or short spiral auger, generally 300 mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

Continuous Sample Drilling — the hole is advanced by pushing a 100 mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling in soils, since moisture content is unchanged and soil structure, strength, etc. is only marginally affected.

Continuous Spiral Flight Augers — the hole is advanced using 90—115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow

soil classification is required, direct drilling and sampling may be preferable.

Hand Penetrometers

Hand penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150 mm increments of penetration. Normally, there is a depth limitation of 1.2 m but this may be extended in certain conditions by the use of extension rods.

Two, relatively similar tests are used.

- Perth sand penetrometer — a 16 mm diameter flat ended rod is driven with a 9 kg hammer, dropping 600 mm (AS 1289, Test F 3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as the Scala Penetrometer) — a 16 mm rod with a 20 mm diameter cone end is driven with a 9 kg hammer dropping 510 mm (AS 1289, Test F3.2). The test was developed initially for pavement subgrade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

Laboratory Testing

Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedure used are given on the individual report forms.

Bore Logs

The bore logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable, or possible to justify on economic grounds. In any case, the boreholes represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes, the frequency of sampling and the possibility of other than 'straight line' variations between the boreholes.

Ground Water

Where ground water levels are measured in boreholes, there are several potential problems:

- In low permeability soils, ground water although present, may enter the hole slowly, or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.

- Water table levels will vary from time to time with seasons or recent prior weather changes. They may not be the same at the time of construction as are indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (e.g. a three storey building) the information and interpretation may not be relevant if the design proposal is changed (e.g. to a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface condition, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- unexpected variations in ground conditions — the potential for this will depend partly on bore spacing and sampling frequency.
- changes in policy or interpretation of policy by statutory authorities.
- the actions of contractors responding to commercial pressures.

If these occur, the Company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is

AN ENGINEERING CLASSIFICATION OF SEDIMENTARY ROCKS IN THE SYDNEY AREA

This classification system provides a standardized terminology for the engineering description of the sandstone and shales in the Sydney area, but the terms and definitions may be used elsewhere when applicable.

Under this system rocks are classified by Rock Type, Degree of Weathering, Strength, Stratification Spacing, and Degree of Fracturing. These terms do not cover the full range of engineering properties. Descriptions of rock may also need to refer to other properties (e.g. durability, abrasiveness, etc.) where these are relevant.

ROCK TYPE DEFINITIONS

Rock Type	Definition
Conglomerate:	More than 50% of the rock consists of gravel sized (greater than 2 mm) fragments.
Sandstone :	More than 50% of the rock consists of sand sized (.06 to 2 mm) grains.
Siltstone:	More than 50% of the rock consists of silt-sized (less than .06 mm) granular particles and the rock is not laminated
Claystone:	More than 50% of the rock consists of clay or sericitic material and the rock is not laminated.
Shale:	More than 50% of the rock consists of silt or clay sized particles and the rock is laminated.

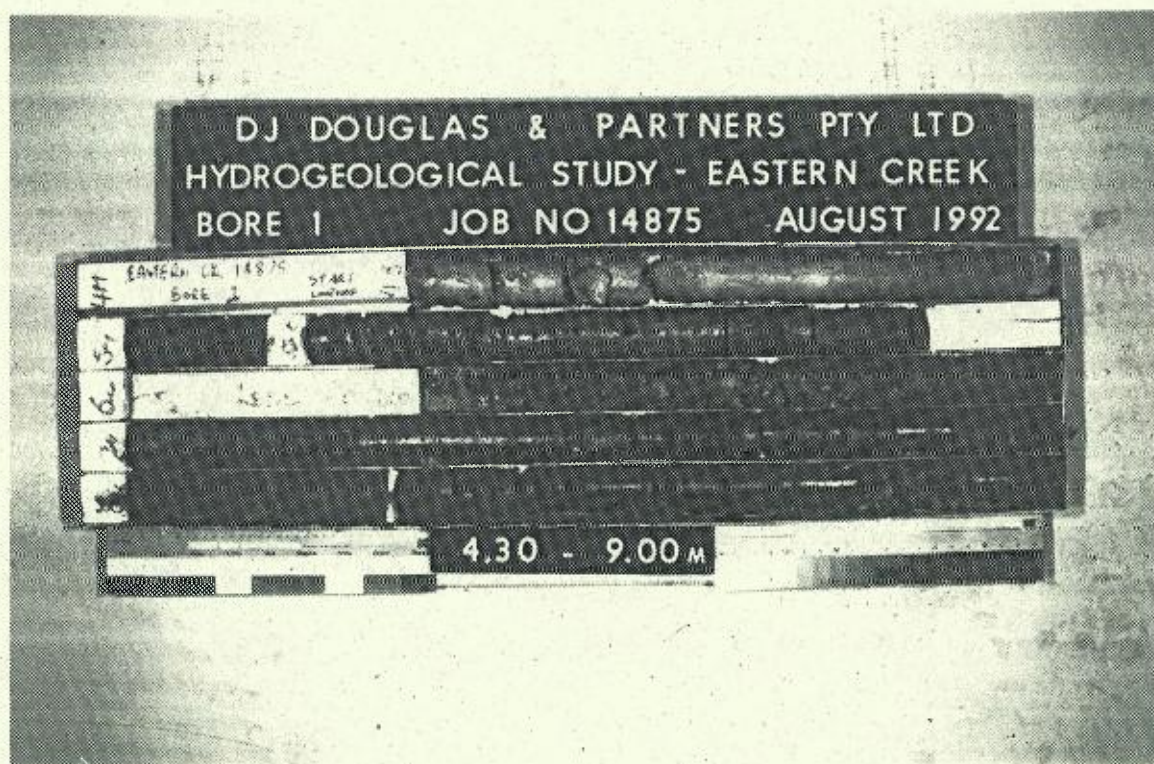
Rocks possessing characteristics of two groups are described by their predominant particle size with reference also to the minor constituents, e.g. clayey sandstone, sandy shale.

DEGREE OF WEATHERING

Term	Symbol	Definition
Extremely Weathered	EW	Rock substance affected by weathering to the extent that the rock exhibits soil properties — i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.
Highly Weathered	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
Moderately Weathered	MW	Rock substance affected by weathering to the extent that staining extends throughout the whole of the rock substance and the original colour of the fresh rock is no longer recognisable.
Slightly Weathered	SW	Rock substance affected by weathering to the extent that partial staining or discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable.
Fresh	Fr	Rock substance unaffected by weathering.

STRATIFICATION SPACING

Term	Separation of Stratification Planes
Thinly laminated	<6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	>2m



TEST BORE REPORT

DATE 10/11.8.92

CLIENT WASTE RECYCLING AND PROCESSING SERVICE

PROJECT No 14875

BORE No 1

PROJECT EASTERN CREEK WASTE DEPOT

SURFACE LEVEL -

SHEET 1 OF 2

LOCATION EASTERN CREEK

DIP OF HOLE 90°

AZIMUTH -

Depth m	Description of Core	Degree of Weathering FS SW MW FW EW	Graphic Log	Discontinuities B - Bedding J - Joint S - Shear D - Drill Break	Rock Strength Ex. Low Very Low Low Medium High Very High Ex. High	Fracture Spacing (m) 1.00 0.50 0.10 0.05 0.01	Sampling & In Situ Testing			
							Sample Type	Core Rec. %	RQD %	Test Results & Comments
0.2	SILTY CLAY - brown silty clay									
1	SILTY CLAY - light grey and brown silty clay with some extremely low strength siltstone layers below 3.0m						A			
2							A			
3							U			
4							A			
4.30							A			
4.85							U			
5	SILTSTONE AND SHALE - very low strength highly to moderately weathered fractured dark grey and brown interbedded siltstone and shale with some low strength layers			4.30-15.00m Defects are generally B partings 0-5° planar to undulating Many of which have opened during on subsequent to drilling The core has several fragmented and highly fractured layers most likely due to drilling			C	97		4.30
5.20							C	100		5.20
5.85				*Core losses may be due to extremely low strength or highly fractured layers being washed away during drilling	CORE LOSS 600mm					5.85
6										
7										
7.2	SILTSTONE AND SHALE - medium strength slightly weathered fractured dark grey interbedded siltstone and shale with some highly fractured layers						C	75		
8										
8.25				J 85° rough						8.25
9							C	94		
					CORE LOSS 100mm					

RIG B20

DRILLER Cooper

LOGGED

Murray/McMorran

CASING

To 4.5m

TYPE OF BORING Solid flight auger GL to 4.3m then NMLC coring to 15.00m

WATER OBSERVATIONS Free ground water observed at 2.8m

REMARKS

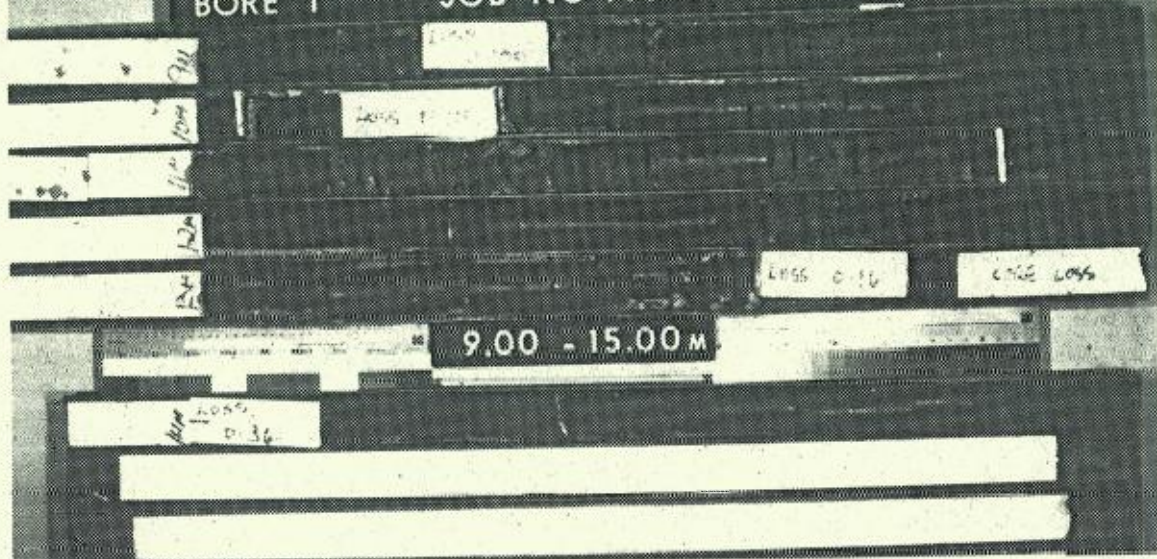
SAMPLING & IN SITU TESTING

A - auger sample PL - point load strength $f_{(50)}$ (MPa)
B - bulk sample S - standard penetration test
C - core dialog Ux - 2 mm dia tube



D.J. Douglas & Partners

DJ DOUGLAS & PARTNERS PTY LTD
HYDROGEOLOGICAL STUDY - EASTERN CREEK
BORE 1 JOB NO 14875 AUGUST 1992



TEST BORE REPORT

DATE 10/11.8.92

CLIENT WASTE RECYCLING AND PROCESSING SERVICE

PROJECT No 14875

BORE No 1

PROJECT EASTERN CREEK WASTE DEPOT

SURFACE LEVEL

SHEET 2 OF 2

LOCATION EASTERN CREEK

DIP OF HOLE 90°

AZIMUTH -

Depth m	Description of Core	Degree of Weathering FR FS SW MW HW EW	Graphic Log	Discontinuities B - Bedding S - Shear J - Joint D - Drill Break	Rock Strength Ex. Low Very Low Low Medium High Very High Ex. High	Fracture Spacing (m) 1.00 0.50 0.10 0.05 0.01	Sampling & In Situ Testing			
							Sample Type	Core Rec. %	RQD %	Test Results & Comments
11	SILTSTONE AND SHALE - medium to high strength fresh fractured dark grey interbedded siltstone and shale with some highly fractured layers			J 80-90° undulating rough			C	92		
12										11.85
13							C	92		
14										13.76
15.0	BORE DISCONTINUED AT 15.00 METRES									
16										
17										
18										
19										

RIG R20

DRILLER Cooper

LOGGED Murray/McMorran

CASING

To 4.5m

TYPE OF BORING Solid flight auger GL to 4.5m then NMLC coring to 15.00m

WATER OBSERVATIONS Free ground water observed

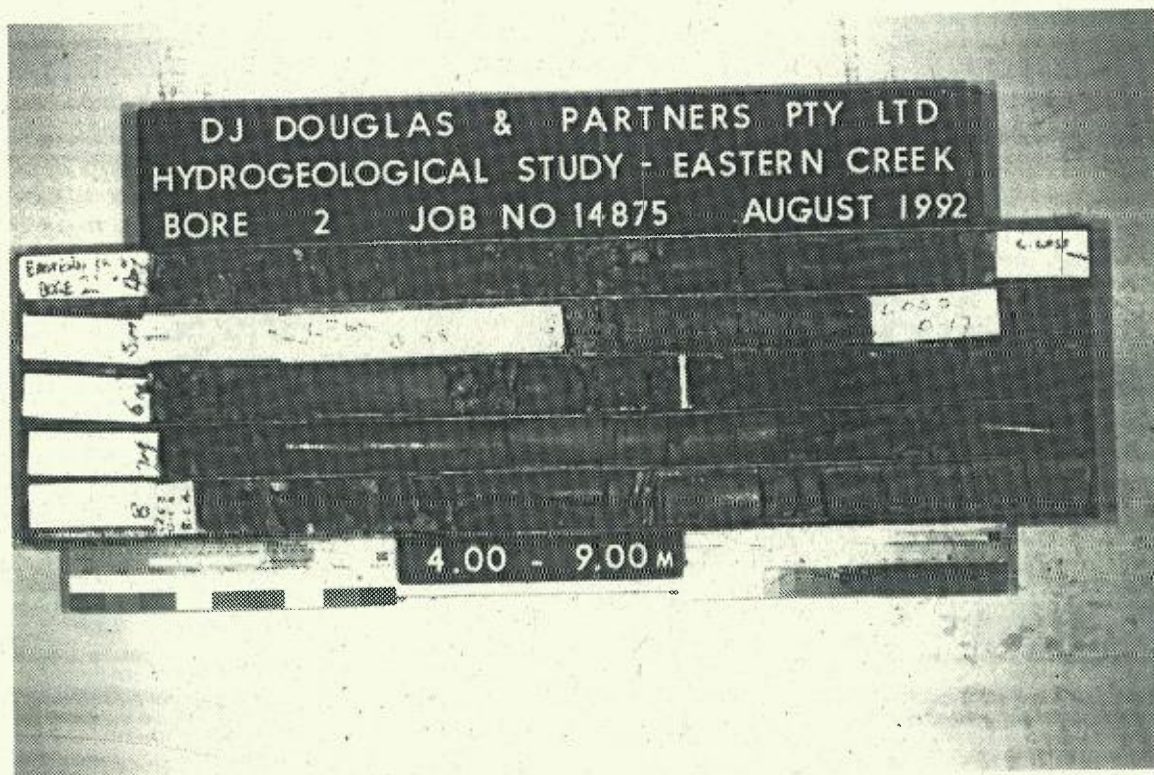
REMARKS

SAMPLING & IN SITU TESTING

- A auger sample
- B bulk sample
- C core drilling
- PI point load strength $I_p(50)$ (MPa)
- S standard penetration test
- Ux x mm dia tube



D.J. Douglas & Partners



TEST BORE REPORT

DATE 12/13.8.92

CLIENT WASTE RECYCLING AND PROCESSING SERVICE
 PROJECT EASTERN CREEK WASTE DEPOT
 LOCATION EASTERN CREEK

PROJECT No 14875

SURFACE LEVEL

DIP OF HOLE 90°

BORE No 2

SHEET 1 OF 2

AZIMUTH

Depth m	Description of Core	Degree of Weathering FR LS SS SW NW SE EW	Graphic Log	Discontinuities B - Bedding J - Joint S - Shear D - Drill Break	Rock Strength E: Low Very Low Low Medium High Very High E: High	Fracture Spacing (m) 1.00 0.50 0.10 0.05 0.01	Sampling & In Situ Testing			
							Sample Type	Core Rec. %	RQD %	Test Results & Comments
0.7	FILLING - brown and red brown clayey silt filling						A			
1	FILLING - grey and brown ripped shale filling						A			
1.2	SILTY CLAY - grey, brown and red brown silty clay with some ironstone bands -grades to siltstone and shale below						U			
2							A			
3							A			
3.2							U			
4	SILTSTONE AND SHALE - very low to low strength moderately weathered highly fractured to fractured dark grey and brown interbedded siltstone and shale			Much of the core is fragmented or highly fractured probably due in part to drilling and handling and subsequent drying of core 3.20-6.90m Most defects are B partings 0-5° many of which have probably opened during drilling and handling Much of the core is desiccated due to drying out						4.00
5				*core losses may be due to extremely low to very low strength layers being washed away during drilling			C	62	0	
										5.45
6							C	69		
										6.00
6.9							C	100		
7	SANDSTONE - medium to high strength moderately to slightly weathered fractured to slightly fractured grey and brown fine grained sandstone with some low strength siltstone interbeds			6.90-9.55m unless specified defects 0-5° generally planar many of which have probably opened during drilling			C	96	50	6.58
8										8.04
9				J 80-90° undulating			C	100	50	
9.55	SILTSTONE AND SHALE - see description over			J 65° rough						

RIG

R20

DRILLER

Cooper

LOGGED Murray/McMorran

CASING to 4.00m

TYPE OF BORING Solid flight auger GL to 4.0m then NMLC coring to 14.90m, hole reamed to 15.00m

WATER OBSERVATIONS No free ground water observed

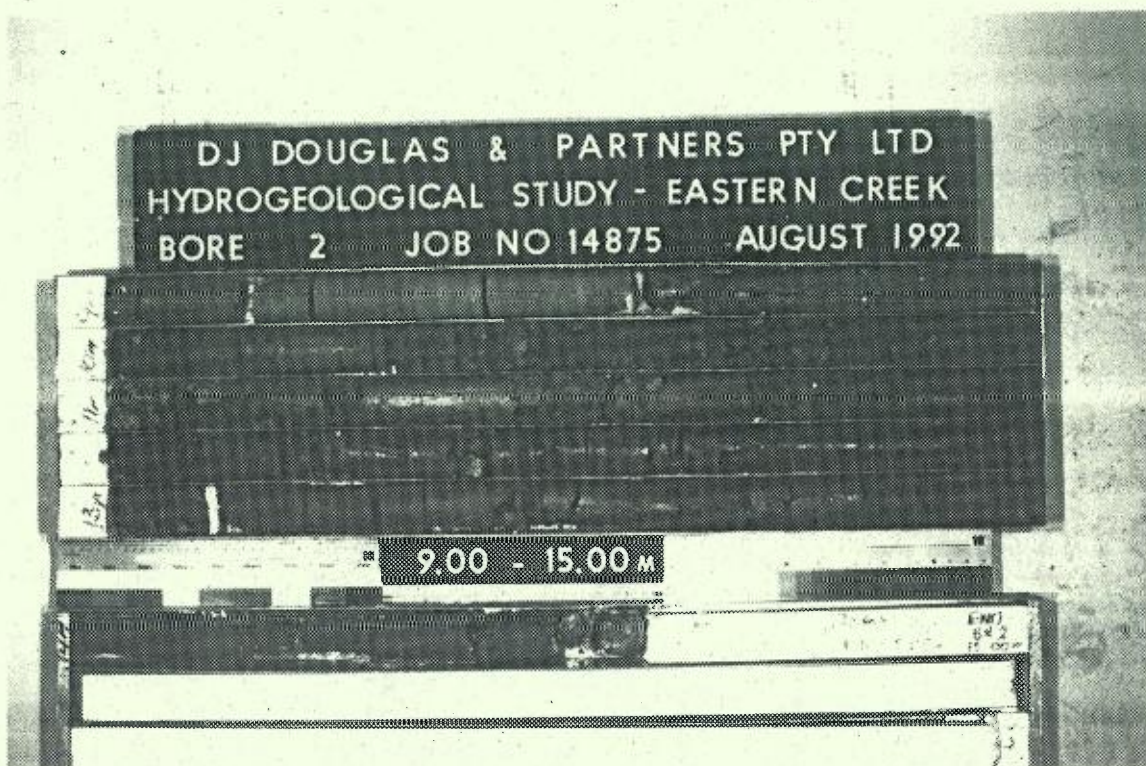
REMARKS RQD and fracture logs are possibly underestimated due to highly fractured nature of core

SAMPLING & IN SITU TESTING

A - auger sample PL - point load strength $I_p(50)(\text{MPa})$
 B - bulk sample S - standard penetration test
 C - core (dialing) Us - x mm dia tube
 DP - pocket penetrometer (kPa)



D.J. Douglas & Partners



DJ DOUGLAS & PARTNERS PTY LTD
HYDROGEOLOGICAL STUDY - EASTERN CREEK
BORE 2 JOB NO 14875 AUGUST 1992

9.00 - 15.00 M

TEST BORE REPORT

DATE 12/13.8.92

CLIENT
PROJECT
LOCATION

WASTE RECYCLING AND PROCESSING SERVICE
EASTERN CREEK WASTE DEPOT
EASTERN CREEK

PROJECT No 14901
SURFACE LEVEL
DIP OF HOLE 90°

BORE No 2
SHEET 2 OF 2
AZIMUTH -

Depth m	Description of Core	Degree of Weathering FR FS SW AW HW EW	Graphic Log	Discontinuities B - Bedding J - Joint S - Shear D - Drill Break	Rock Strength Ex. Low Very Low Low Medium High Very High Ex. High	Fracture Spacing (m) 1.00 0.50 0.10 0.05 0.01	Sampling & In Situ Testing			
							Sample Type	Core Rec. %	RQD %	Test Results & Comments
11	SILTSTONE AND SHALE - very low to low strength slightly weathered highly fractured to fractured dark grey interbedded siltstone and shale with some medium strength layers and minor extremely low strength layers			9.55-14.50m Most defects are B partings 0-5° Many of which are probably due to drilling and handling Much of the core is fragmented or desicated probably in part due to drying out.			C	100	45	11.80
12							C	100		
13										13.10
14							C	78	25	
15.0	*core loss may represent core left in bore hole			CORE LOSS	400mm				14.90	
BORE DISCONTINUED AT 15.00 METRES										
16										
17										
18										
19										

RIG B20 DRILLER Cooper LOGGED Murray/McMorran CASING to 4.00m

TYPE OF BORING Solid flight auger GL to 4.0m then NMLC coring to 14.90m, hole reamed to 15.00m

WATER OBSERVATIONS No free ground water observed

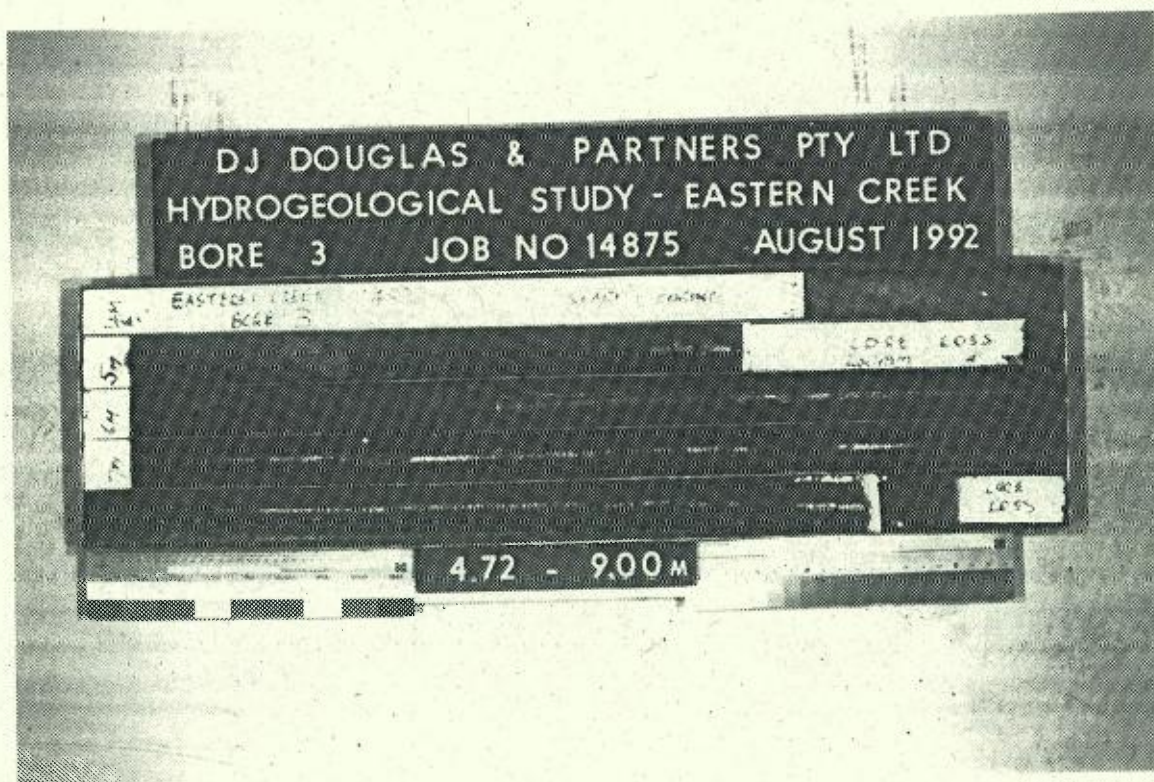
REMARKS RQD and fracture logs are possibly underestimated due to highly fractured nature of core

SAMPLING & IN SITU TESTING

A auger sample PL point load strength $I_p(50)(MPa)$
B bulk sample S standard penetration test
C core drilling Ux x mm dia tube



D.J. Douglas & Partners



DATE: 30.7.92 - 4.8.92

CLIENT	WASTE RECYCLING AND PROCESSING SERVICE
PROJECT	EASTERN CREEK WASTE DEPOT
LOCATION	EASTERN CREEK

PROJECT No 14875

BORE No 3

SURFACE LEVEL

SHEET 1 OF 2

DIP OF HOLE 90^0

AZIMUTH

Depth m	Description of Core	Degree of Weathering FR FIS ES SW NW FW EW	Graphic Log	Discontinuities B - Bedding J - Joint S - Shear D - Drill Break	Rock Strength Ext. Low Very Low Low Medium High Very High Ext. High	Fracture Spacing (m) 1.00 0.50 0.10 0.05 0.01	Sampling & In Situ Testing			
							Sample Type	Core Rec. %	RQD %	Test Results & Comments
0.7	CLAYEY SILT - brown clayey silt with some ironstone gravel						A			
1	SILTY CLAY - brown and red brown silty clay						A			
2							U			
2.3	CLAY - grey and brown slightly silty clay						A			
3							A			
3.8							U			
4	SILTSTONE AND SHALE - extremely low strength light grey and brown interbedded siltstone and shale with some very low strength layers and clay layers			4.72-14.70m Unless otherwise specified defects are B partings 0-10° planar to irregular many of which have opened during or subsequent to drilling			A			
5				Much of the core contains breaks due to drilling and handling J 45°-85° curved			A			
5.65							U			4.72
6				*core losses possibly due to extremely low to very low strength siltstone or shale being washed away during drilling	CORE LOSS 260mm		C	100	20	
6.4	SILTSTONE AND SHALE - medium strength slightly weathered to fresh fractured to slightly fractured dark grey and grey interbedded siltstone and shale									5.65
7										
8										
8.1	SILTSTONE AND SHALE - medium to high strength fresh slightly fractured dark grey interbedded siltstone and shale			J 60°						
8.75										
9					CORE LOSS 280mm		C	92	65	

RIG R20

DRILLER Cooper

LOGGED Murray/McMorran

CASING to 5.00m

TYPE OF BORING Solid flight auger GL to 4.5m NMLC coring 4.72 to 14.7m then rotary to 15.00m

WATER OBSERVATIONS No free ground water observed whilst augering. Find water level 1.9m.

REMARKS

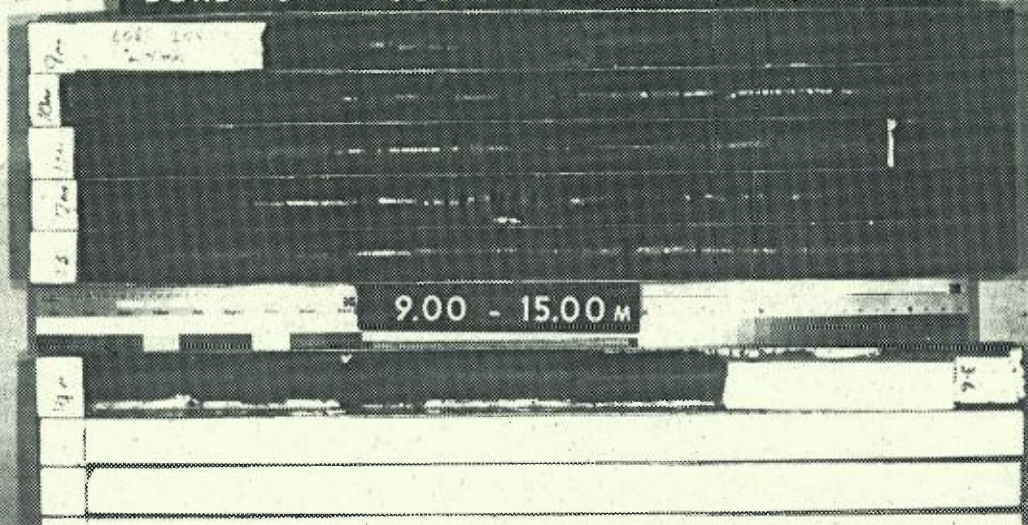
SAMPLING & IN SITU TESTING

A	auger sample	PL	point load strength $I_{\text{p}}(50)(\text{MPa})$
B	bulk sample	S	standard penetration test
C	core drilling	1/2 x	x mm dia tube



D.J. Douglas & Partners

DJ DOUGLAS & PARTNERS PTY LTD
HYDROGEOLOGICAL STUDY - EASTERN CREEK
BORE 3 JOB NO 14875 AUGUST 1992



TEST BORE REPORT

DATE 30.7.92 - 4.8.92

CLIENT WASTE RECYCLING AND PROCESSING SERVICE
PROJECT EASTERN CREEK WASTE DEPOT
LOCATION EASTERN CREEK

PROJECT No 14875

BORE No 3

SURFACE LEVEL

SHEET 2 OF 2

DIP OF HOLE 90°

AZIMUTH

Depth m	Description of Core	Degree of Weathering FR FS SW MW HW EW	Graphic Log	Discontinuities B - Bedding J - Joint S - Shear D - Drill Break	Rock Strength Ext. Low Very Low Low Medium High Very High Ext. High	Fracture Spacing (m) 1.00 0.50 0.10 0.05 0.01	Sampling & In Situ Testing			
							Sample Type	Core Rec. %	RQD %	Test Results & Comments
11	SILTSTONE AND SHALE - medium to high strength fresh fractured to slightly fractured dark grey interbedded siltstone and shale			J 60° stepped			C	91	80	11.85
12										
13							C	100	70	
14										
15.0							BORE DISCONTINUED AT 15.00 METRES			
16										
17										
18										
19										

RIG B30 DRILLER Cooper LOGGED Murray/McMorran CASING to 5.00m

TYPE OF BORING Solid flight auger G1 to 4.5m HMLC coring 4.72 to 14.7m then rotary to 15.00m

WATER OBSERVATIONS No free ground water observed whilst augering. Fine water level 1.9m.

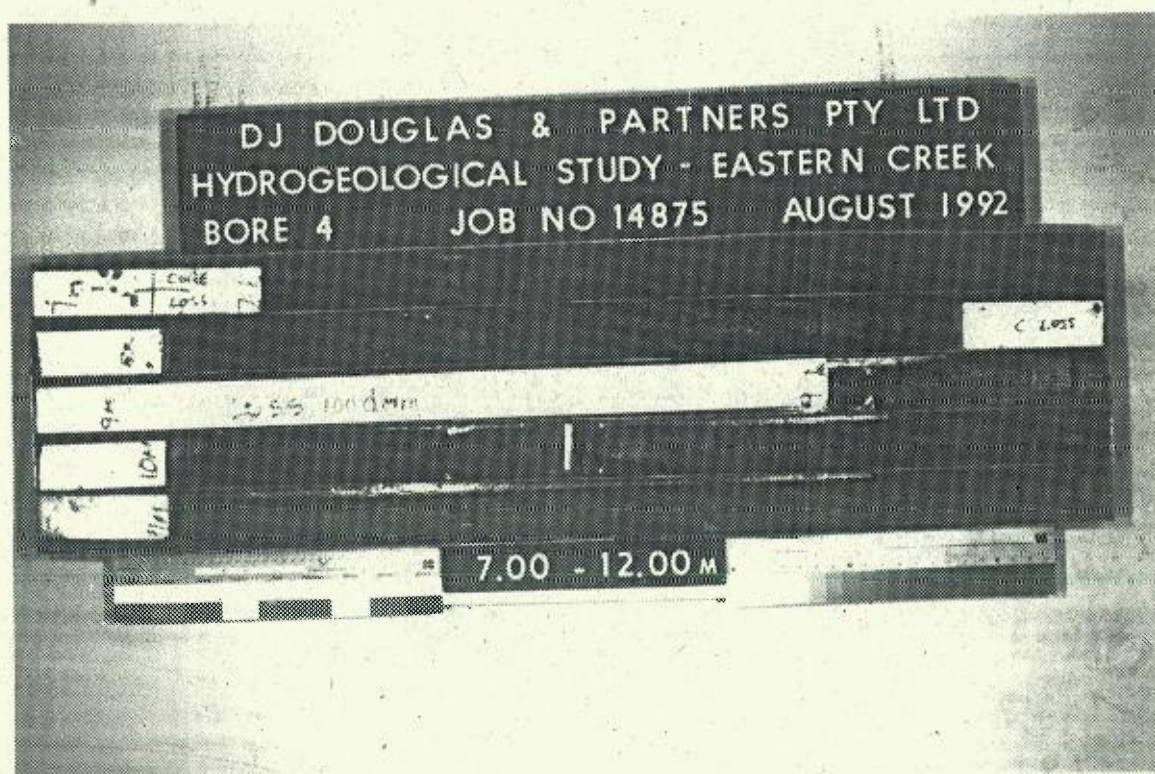
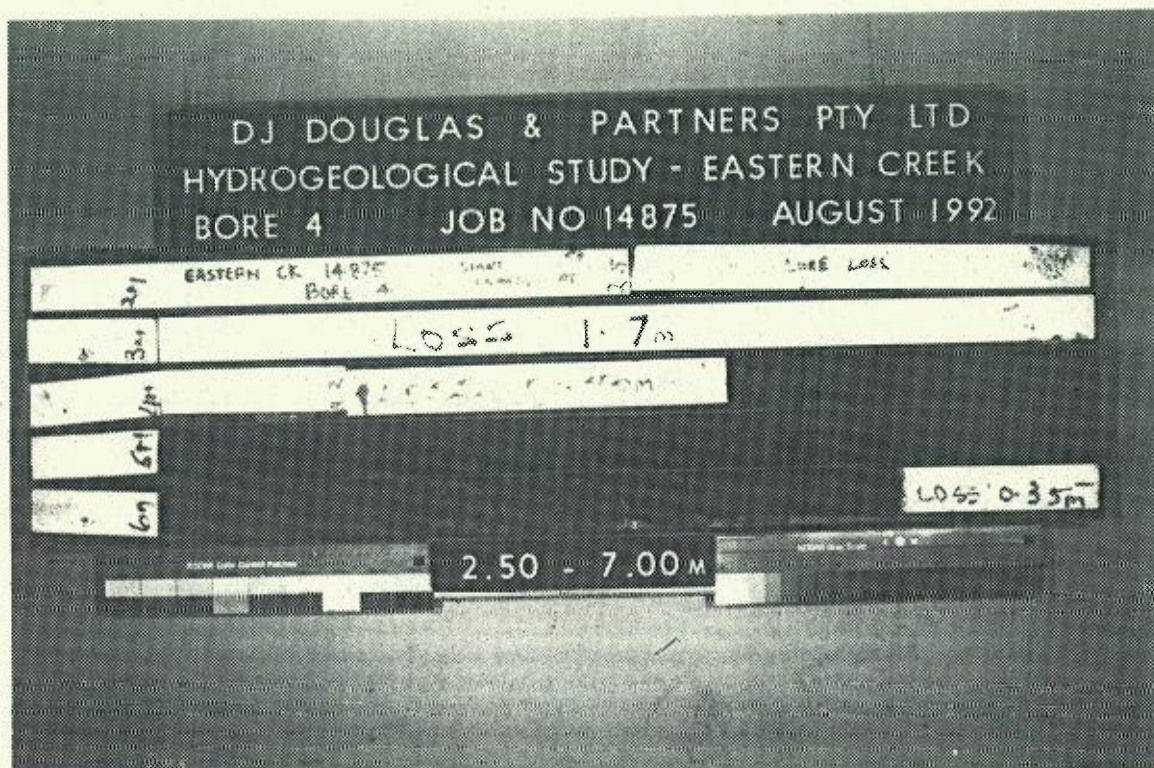
REMARKS

SAMPLING & IN SITU TESTING

A - auger sample PL - point load strength $I_p(50)$ (MPa)
B - bulk sample S - standard penetration test
C - core drilling Ux - x mm dia tube



D.J. Douglas & Partners



DATE 6/7.8.92

CLIENT	WASTE RECYCLING AND PROCESSING SERVICE
PROJECT	EASTERN CREEK WASTE DEPOT
LOCATION	EASTERN CREEK

PROJECT No 14875


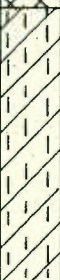











BORE No 4

SURFACE LEVEL

SHEET 1 OF 2

DIP OF HOLE 90^0

AZIMUTH

Depth m	Description of Core	Degree of Weathering FR FS SW LW SH EW	Graphic Log	Discontinuities B - Bedding J - Joint S - Shear D - Drill Break	Rock Strength Es. Low Very Low Low Medium High Very High Ex. High	Fracture Spacing (m) 1.00 0.50 0.10 0.05 0.01	Sampling & In Situ Testing			Test Results & Comments	
							Sample Type	Core Rec. %	RQD %		
0.7	FILLING - grey and brown silty clay and shale filling							A			
1	SILTY CLAY - light grey brown silty clay with some fine to medium ironstone gravel			*Much of the core is fragmented probably due in part to drilling				A			
2								U			
3								A			2.50
4				*core losses possibly due to drill bit blocking in extremely low to very low strength of highly fractured siltstone or shale and grinding away rest of run				C	0	-	
4.5											4.20
5	SILTSTONE AND SHALE - very low strength highly weathered highly fractured to fractured grey and brown interbedded siltstone and shale			4.60-9.70m Defects are generally B partings 0-5° Many of which have probably opened due to drilling and handling or subsequent drying				C	78	35	6.00
6								C	68		
7											7.10
7.1											
8	SILTSTONE AND SHALE - very low to low strength moderately to slightly weathered highly fractured to fractured dark grey interbedded siltstone and shale							C	62	0	
9											
9.7											9.70
								C	100		

RIG B20

DRILLER Cooper

LOGGED Murray/McMorran.

CASING 1.0-3.0m

TYPE OF BORING Solid flight auger GL to 2.5m, then NMLC coring to 15.00m

WATER OBSERVATIONS No free ground water observed

REMARKS

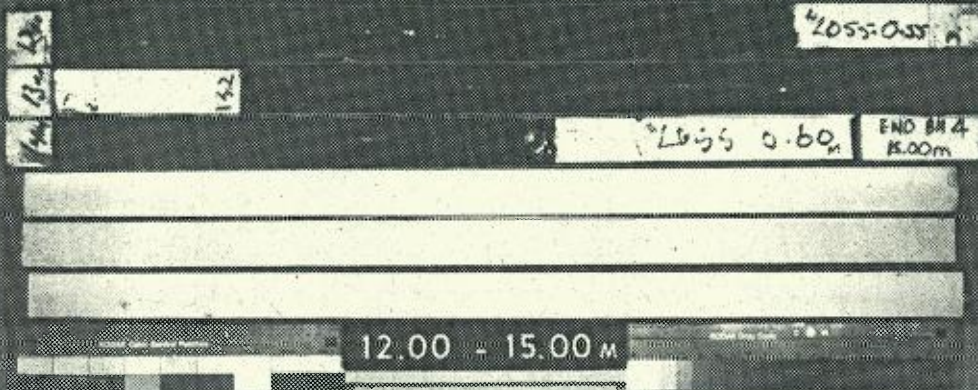
SAMPLING & IN SITU TESTING

A	auger sample	Pl	point load strength $I_{\text{p}}(50)(\text{MPa})$
B	bulk sample	S	standard penetration test
C	core drilling	Ux	x mm (dia. tube)



D.J. Douglas & Partners

DJ DOUGLAS & PARTNERS PTY LTD
HYDROGEOLOGICAL STUDY - EASTERN CREEK
BORE 4 JOB NO 14875 AUGUST 1992



TEST BORE REPORT

DATE 6/7.8.92

CLIENT
PROJECT
LOCATION

WASTE RECYCLING AND PROCESSING SERVICE
EASTERN CREEK WASTE DEPOT
EASTERN CREEK

PROJECT No 14875
SURFACE LEVEL
DIP OF HOLE 90°

BORE No 4
SHEET 2 OF 2
AZIMUTH

Depth m	Description of Core	Degree of Weathering FS SW MW HW EW	Graphic Log	Discontinuities B - Bedding S - Shear J - Joint O - Drill Break	Rock Strength Ex. Low Very Low Low Medium High Very High Ex. High	Fracture Spacing (m) 1.00 0.50 0.10 0.05 0.01	Sampling & In Situ Testing			
							Sample Type	Core Rec. %	ROD %	Test Results & Comments
11	SILTSTONE AND SHALE - medium to high strength fresh fractured to slightly fractured dark grey inter- bedded siltstone and shale with some slightly weathered highly fractured layers below 13.2m			9.70-14.40m Defects are predom- inantly B partings 0-5° planar to undulating, many of which are probably opened due to drilling and handling or subsequent drying Minor subvertical joints between B- partings below 13.2m						10.25
12							C	81	90	
13										
14										
15.0	BORE DISCONTINUED AT 15.00 METRES									
16										
17										
18										
19										

RIG B20 DRILLER Cooper LOGGED Murray/McMorran CASING 1 to 3.0m

TYPE OF BORING Solid flight auger GL to 2.5m then NMLC coring to 15.00m

WATER OBSERVATIONS No free ground water observed

REMARKS

SAMPLING & IN SITU TESTING

A auger sample PL point load strength $I_p(50)(\text{MPa})$
B bulk sample S standard penetration test
C core drilling 115 x mm dia tube
OW cracked rock strength (kPa)



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HYDROGEOLOGICAL STUDY - EASTERN CREEK
BORE 5 JOB NO 14875 AUGUST 1992

EASTERN CREEK

4.60 - 9.00 M

TEST BORE REPORT

DATE 4/6.8.92

CLIENT
PROJECT
LOCATIONWASTE RECYCLING AND PROCESSING SERVICE
EASTERN CREEK WASTE DEPOT
EASTERN CREEKPROJECT No 14875
SURFACE LEVEL
DIP OF HOLE 90°BORE No 5
SHEET 1 OF 2
AZIMUTH

Depth m	Description of Core	Degree of Weathering FR LS SW MW RW FW EW	Graphic Log	Discontinuities B - Bedding S - Shear J - Joint D - Drill Break	Rock Strength Es Low Very Low Low Medium High Very High Es High	Fracture Spacing (m) 1.00 0.50 0.10 0.05 0.01	Sampling & In Situ Testing			
							Sample Type	Core Rec. %	RQD %	Test Results & Comments
0.75	CLAYEY SILT - grey and brown clayey silt						A			
1	SILTY CLAY - grey and brown silty clay with some ironstone gravel						A			
1.90	CLAY - grey and brown slightly silty clay with some extremely low to very low strength siltstone layers below 4.6m			*some of the core is fragmented or highly fractured probably due in part to drilling and handling			U			
2							A			
3							A			
4							U			
5	SANDSTONE AND SILTSTONE - very low to low strength highly to moderately weathered highly fractured brown and light grey interbedded fine grained sandstone and siltstone			5.15-6.85m Most defects are B partings 0-5° generally planar along micaceous laminae some are ironstained Some Subvertical joints spacing 50-500mm ironstained *core losses possibly due to extremely low or highly fractured siltstone or shale being washed away during drilling						
5.15							C	73	0	
6	SANDSTONE AND SILTSTONE - medium to high strength slightly weathered to fresh fractured light grey and grey interbedded fine grained sandstone and siltstone with some slightly fractured layers			6.85-8.95m Unless otherwise specified defects are generally B partings 5-15° planar along micaceous laminae Many have probably opened due to drilling and handling J subvertical closed in sandstone J 45° irregular in siltstone						
6.85										
7	SILTSTONE AND SHALE - very low to low strength moderately weathered highly fractured grey and dark grey interbedded siltstone and shale									
7										
8	SILTSTONE AND SHALE - see over									
8.95										
9	SILTSTONE AND SHALE - see over									
9										
9.95	SILTSTONE AND SHALE - see over									

RIG B20 DRILLER Cooper LOGGED Murray/McMorran CASING To 5.00m

TYPE OF BORING Solid flight auger GL to 4.5m then NMLC coring to 15.00m

WATER OBSERVATIONS No free ground water observed whilst augering. Find water level after drilling at 2.3m.

REMARKS

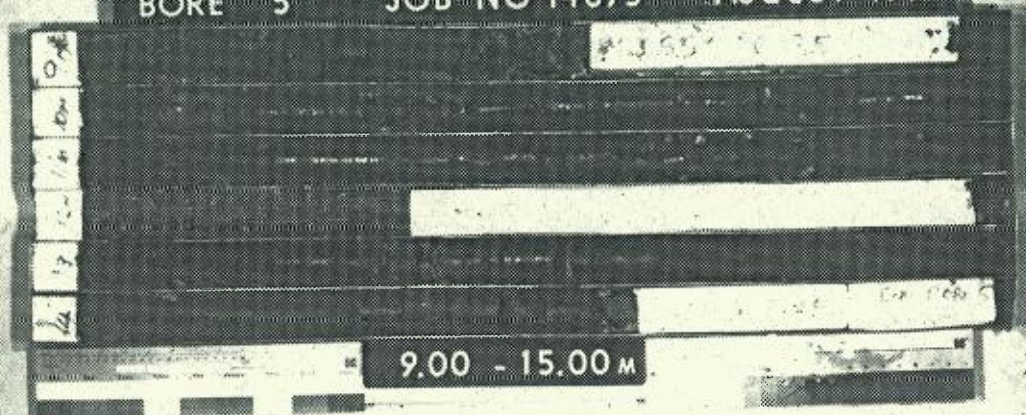
SAMPLING & IN SITU TESTING

A - auger sample
B - bulk sample
C - core drilling
PI - point load strength $I_p(50)(\text{MPa})$
S - standard penetration test
G - 4 mm dia tube



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HYDROGEOLOGICAL STUDY - EASTERN CREEK
BORE 5 JOB NO 14875 AUGUST 1992



TEST BORE REPORT

DATE 4/6.8.92

CLIENT
PROJECT
LOCATION

WASTE RECYCLING AND PROCESSING SERVICE
EASTERN CREEK WASTE DEPOT
EASTERN CREEK

PROJECT No 14875
SURFACE LEVEL
DIP OF HOLE 90°

BORE No 5
SHEET 2 OF 2
AZIMUTH

Depth m	Description of Core	Degree of Weathering FR FS SW MW HW EW	Graphic Log	Discontinuities B - Bedding J - Joint S - Shear D - Drill Break	Rock Strength Ext. Low Very Low Low Medium High Very High Ext. High	Fracture Spacing (m) 1.00 0.50 0.10 0.05 0.01	Sampling & In-Situ Testing			
							Sample Type	Core Rec. %	RQD %	Test Results & Comments
11	SILTSTONE AND SHALE - medium strength slightly weathered to fresh fractured dark grey and grey interbedded siltstone and shale with some highly fractured layers	FS								
12		FS								
12.05	SILTSTONE AND SHALE - very low to low strength moderately weathered highly fractured grey interbedded siltstone and shale	SW								
12.95		SW								
12.95	SILTSTONE AND SHALE - medium strength slightly weathered to fresh fractured dark grey and grey interbedded siltstone and shale	SW								
14		SW								
15.00		SW								
15.00	BORE DISCONTINUED AT 15.00 METRES									
16										
17										
18										
19										

RIG B20 DRILLER Cooper LOGGED Murray/McMorran CASING to 5.00m

TYPE OF BORING Solid flight auger GL to 4.5m then NMLC coring to 15.00m

WATER OBSERVATIONS No free ground water observed whilst augering. Find water level after drilling at 2.3m.

REMARKS

SAMPLING & IN SITU TESTING

A auger sample PL point load strength I_{50} (MPa)
B bulk sample S standard penetration test
C core drilling Th x mm dia tube
m core bed discontinuities (B.P.)



D.J. Douglas & Partners

TEST BORE REPORT

DATE 13.1.93

PROJECT No 14875

BORE No 6

SURFACE LEVEL

SHEET 1 OF 3

DIP OF HOLE 45°

AZIMUTH 325°

CLIENT WRAPS
PROJECT HYDROGEOLOGICAL STUDY
LOCATION EASTERN CREEK

Depth m	Description of Core	Degree of Weathering FR LS SW SWS EW	Graphic Log	Discontinuities		Rock Strength					Fracture Spacing (m)		Sampling & In Situ Testing			
				B - Bedding S - Shear	J - Joint D - Drill Break	Ext Low Very Low Low Medium High Very High Ext High	1.00 0.50 0.10 0.05 0.01					Sample Type	Core Rec. %	RQD %	Test Results & Comments	
1	CLAY - very stiff to hard light brown clay.															
2																
3																
4	-moist to wet at 4-5m															
5																
6	-sandy at 6m															
7	-ironstone gravel at 7m															
8																
8.20																
9	SILTSTONE - very low to low strength highly to moderately weathered, slightly fractured light grey, brown and red brown siltstone moderate ironstaining at 9.0-9.15m															
9.85																

RIG Scout

DRILLER Cooper

LOGGED McMorran

CASING GL to 8m

TYPE OF BORING Rotary drilling from GL to 8m then NQ coring

WATER OBSERVATIONS

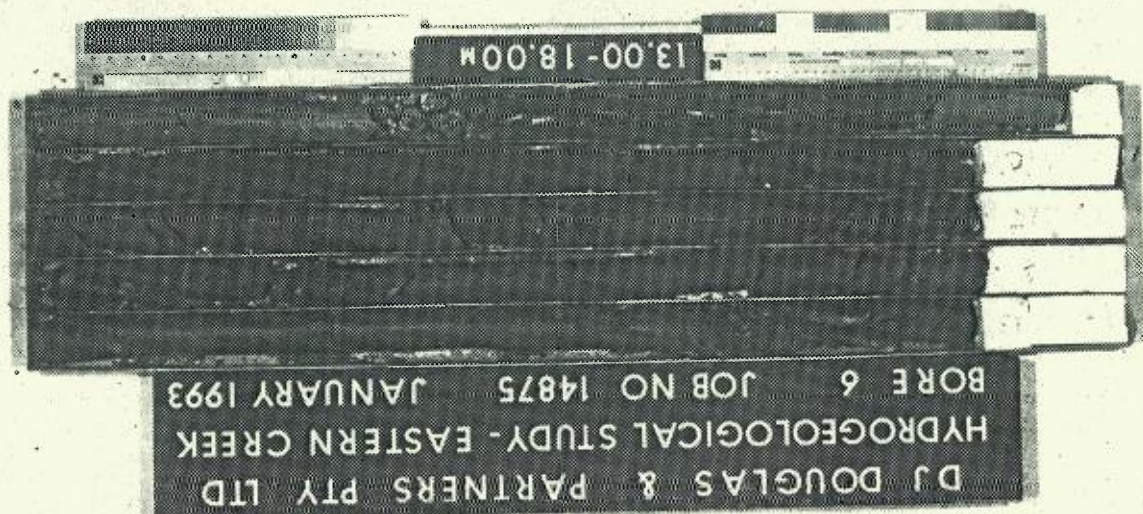
REMARKS

SAMPLING & IN SITU TESTING

A auger sample PL point load strength $I_p(50)$ (MPa)
B bulk sample S standard penetration test
C core drilling Ux x mm dia tube



D.J. Douglas & Partners



TEST BORE REPORT

DATE 13.1.93

PROJECT No 14875

BORE No 6

SURFACE LEVEL

SHEET 2 OF 3

DIP OF HOLE 45°

AZIMUTH 325°

CLIENT
PROJECT
LOCATION

WRAPS
HYDROGEOLOGICAL STUDY
EASTERN CREEK

Depth m	Description of Core	Degree of Weathering <div>FR FS SW MW LW EW</div>	Graphic Log	Discontinuities <div>B - Bedding S - Shear</div> <div>J - Joint D - Drill Break</div>	Rock Strength <div>Ext. Low Very Low Low Medium High Very High Ext. High</div>	Fracture Spacing (m) <div>1.00 0.50 0.10 0.05 0.01</div>	Sampling & In Situ Testing					
							Sample Type	Core Rec. %	RQD %	Test Results & Comments		
11	SILTSTONE - medium strength fresh, slightly fractured light grey siltstone, with some high strength very fine grained sandstone layers and intraclasts			10.6m high angle planar joint								
11.1				11.1m 2 x 45° planar joints							11.0	
12									C	100	95	
13												
13.2	SANDSTONE - medium strength fresh, slightly fractured light grey very fine to fine grained sandstone with some dark grey siltstone laminations			13.2m high angle joints								14.0
13.9	multiple joints at 13.2m											
15	SILTSTONE - low to medium strength slightly weathered to moderately weahtered, slightly fractured dark grey massive siltstone			15m curved fractures on intraclasts					C	100	95	
16	-rounded siltstone intraclast gravel at 15.9-16.0m											
16.85	DYKE - low strength highly weathered slightly fractured light grey dyke			16.85m - vertical contact between dyke and siltstone								16.9
17.05												14 Lu
17.5	SILTSTONE - medium strength moderately weathered fractured dark grey siltstone (contact meta morphosed + 5cm bleached shale)			17.4m (1' or more) vertical joint perpendicular to Dyke					C	100	90	1 Lu
18	DYKE - low strength highly weathered slightly fractured light grey dyke with some white blebs, possibly dolerite											
18.7				18.7m probable drilling breaks in brittle shale								
19	SILTSTONE - low strength moderately weathered slightly fractured to fractured dark grey siltstone + 5cm bleached zone			18.7m vertical contact between dyke and siltstone								
19.7				19.7m 2 x high angle joints								19.7

RIG Scout DRILLER Cooper LOGGED McMorran CASING GL to 8m

TYPE OF BORING Rotary drilling from GL to 8m then NQ coring

WATER OBSERVATIONS High water loss drilling 11.14m

REMARKS

SAMPLING & IN SITU TESTING

A auger sample PL point load strength $I_p(50)$ (MPa)
B bulk sample S standard penetration test
C core drilling Ux x mm dia tube



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HYDROGEOLOGICAL STUDY- EASTERN CREEK
BORE 6 JOB NO 14875 JANUARY 1993

BORE 6A
END 22.7m

18.00- 22.70m

TEST BORE REPORT

DATE 14.1.93

PROJECT No 14875

BORE No 6

SURFACE LEVEL

SHEET 3 OF 3

DIP OF HOLE 45°

AZIMUTH 325°

CLIENT WRAPS
PROJECT HYDROGEOLOGICAL STUDY
LOCATION EASTERN CREEK

Depth m	Description of Core	Degree of Weathering FA FS SW LW FHW FTH	Graphic Log	Discontinuities		Rock Strength					Fracture Spacing (m)		Sampling & In Situ Testing			
				B - Bedding S - Shear	J - Joint D - Drill Break	Es, Low Es, High	Very Low Low Medium High Very High	Es, Low Es, High	Very Low Low Medium High Very High	Es, Low Es, High	1.00 0.50 0.10 0.05 0.01	Sample Type	Core Rec. %	RQD %	Test Results & Comments	
20.4	SANDSTONE - medium strength fresh slightly fractured light grey very fine															
	sandstone grading from siltstone at 19.7m															
21	SILTSTONE - low to medium strength slightly weathered slightly fractured to fractured grey siltstone												C	100	95	5 Lu
22																
22.7																
	BORE DISCONTINUED AT 22.7 METRES															

RIG Scout DRILLER Cooper LOGGED McMorran CASING GL to 8m

TYPE OF BORING Rotary drilling from GL to 8m then NQ coring

WATER OBSERVATIONS

REMARKS Water loss and blockage circulation below dyke

SAMPLING & IN SITU TESTING

- A auger sample
- B bulk sample
- C core drilling
- PL point load strength $I_s(50)$ (MPa)
- S standard penetration test
- Ux x mm dia tube



D.J. Douglas & Partners

TEST BORE REPORT

DATE 15.1.93

PROJECT No 14875

BORE No 7

SURFACE LEVEL

SHEET 1 OF 3

DIP OF HOLE 45°

AZIMUTH 145°

CLIENT WRAPS
PROJECT HYDROGEOLOGICAL STUDY
LOCATION EASTERN CREEK

Depth m	Description of Core	Degree of Weathering FR FS SW NW HW EW	Graphic Log	Discontinuities		Rock Strength					Fracture Spacing (m)				Sampling & In Situ Testing			
				B - Bedding S - Shear	J - Joint D - Drill Break	Ext. Low Very Low Low Medium High Very High Ext. High	1.00 0.50 0.10 0.05 0.01	Sample Type	Core Rec. %	RQD %	Test Results & Comments							
1	CLAY - very stiff to hard light brown clay with some ironstone gravel and very low to low strength shale bands below 6m																	
2																		
3																		
4																		
5																		
6																		
7																		
7.3																		7.3
7.3	SILTSTONE - low strength, moderately weathered to slightly weathered fractured to slightly fractured light brown siltstone			CORE LOSS 0.3m as for between 8m & 8.9m										C	50	0		8.0
8																		
				CORE LOSS 0.9m probably due to washing away of very low strength siltstone														
9																		
9.5	SANDSTONE - low to medium strength fresh slightly fractured light grey very																	

RIG Scout

DRILLER

Cooper

LOGGED

McMorran

CASING

GL to 7.3m

TYPE OF BORING

WATER OBSERVATIONS

Roller bit from GL to 7.3m, then NQ coring to 25.7m

REMARKS

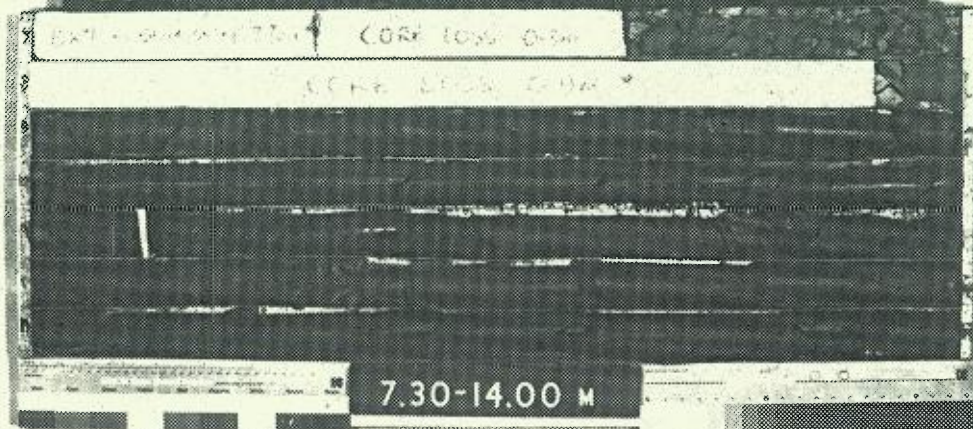
SAMPLING & IN SITU TESTING

- A - auger sample
- B - bulk sample
- C - core drilling
- PL - point load strength $f_L(50)(MPa)$
- S - standard penetration test
- Ø - x mm dia tube



D.J. Douglas & Partners

DJ DOUGLAS & PARTNERS PTY LTD
HYDROGEOLOGICAL STUDY- EASTERN CREEK
BORE 7 JOB NO 14875 JANUARY 1993



DJ DOUGLAS & PARTNERS PTY LTD
HYDROGEOLOGICAL STUDY- EASTERN CREEK
BORE 7 JOB NO 14875 JANUARY 1993



TEST BORE REPORT

DATE 16.1.93

PROJECT No 14875

BORE No 7

SURFACE LEVEL

SHEET 2 OF 3

DIP OF HOLE 45°

AZIMUTH 145°

CLIENT WRAPS
PROJECT HYDROGEOLOGICAL STUDY
LOCATION EASTERN CREEK

Depth m	Description of Core	Degree of Weathering					Graphic Log	Discontinuities		Rock Strength					Fracture Spacing (m)		Sampling & In Situ Testing			
								B - Bedding S - Shear	J - Joint D - Drill Break	Ex. Low Very Low Low Medium High Very High Ex. High	1.00 0.50 0.10 0.05 0.01	Sample Type	Core Rec. %	RQD %	Test Results & Comments					
11	SANDSTONE - medium strength fresh, slightly fractured, light grey very fine grained sandstone, with some dark grey siltstone laminations and dominant dark grey siltstone beds between 11m and 11.5m																			
12																				
13																				
14																				
14.15																				
15	SILTSTONE - low to medium strength, fresh to moderately weathered slightly fractured dark grey siltstone with some very fine grained sandstone																			
16																				
17																				
18																				
18.20																				
19	SANDSTONE - medium strength slightly weathered to fresh slightly fractured light grey very fine grained sandstone with some moderately weathered zones and some dark grey siltstone laminations																			

RIG Scout

DRILLER Cooper

LOGGED

McMorran

CASING GL to 7.3m

TYPE OF BORING Roller bit from GL to 7.3m then NQ coring to 25.7m

WATER OBSERVATIONS

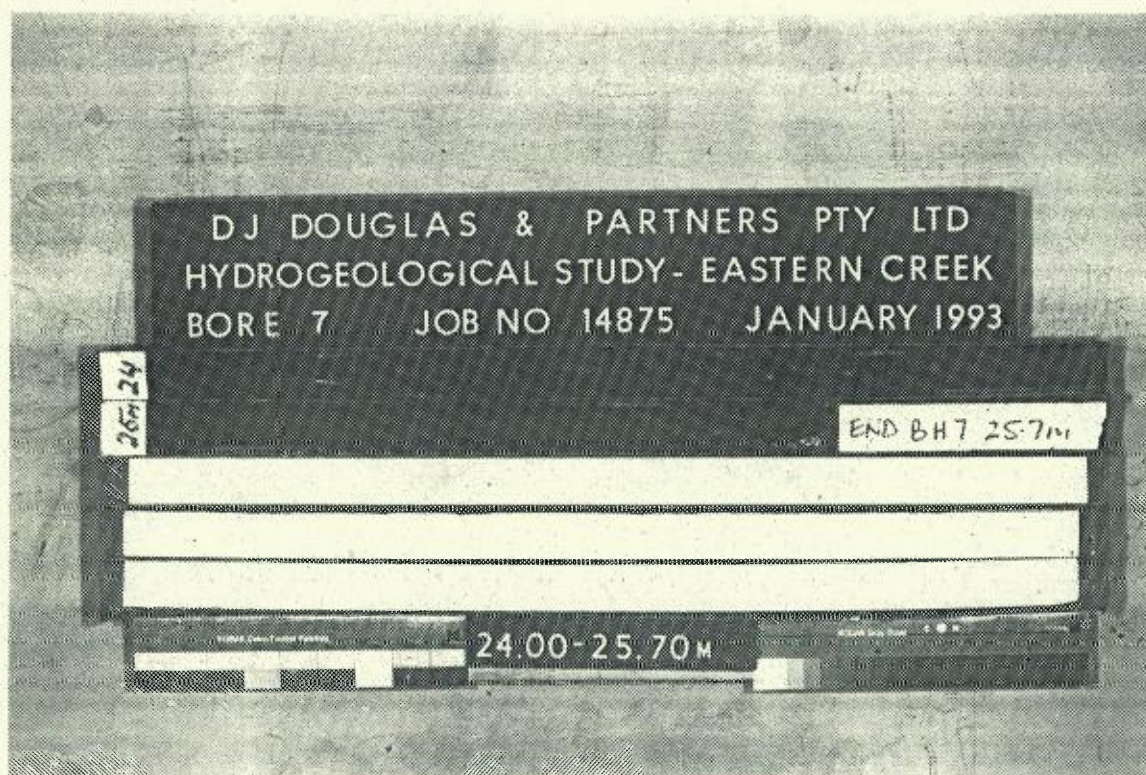
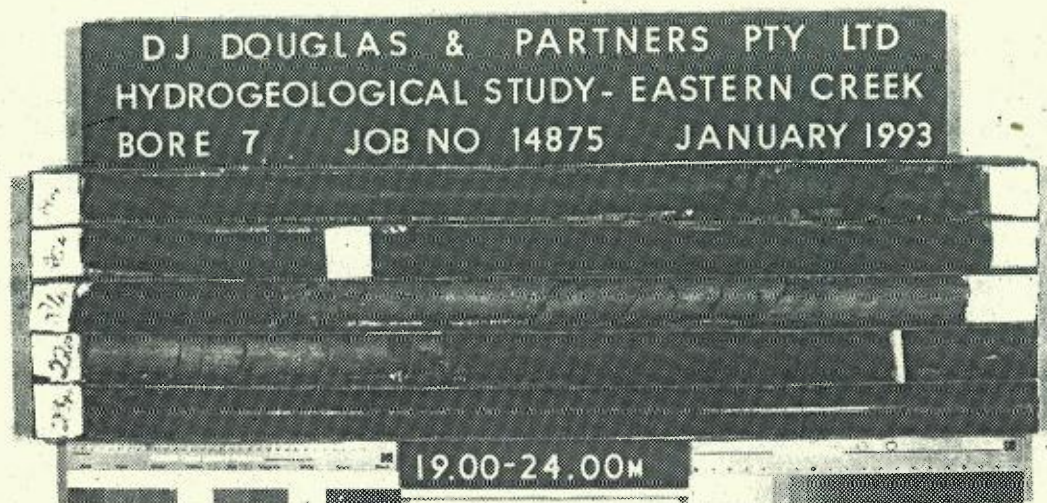
REMARKS

SAMPLING & IN SITU TESTING

A auger sample PL point load strength $I_p(50)$ (MPa)
B bulk sample S standard penetration test
C core drilling UZ = mm dia tube



D.J. Douglas & Partners



TEST BORE REPORT

DATE 16.1.93

CLIENT WRAPS
PROJECT HYDROGEOLOGICAL STUDY
LOCATION EASTERN CREEK

PROJECT No 19875

SURFACE LEVEL

DIP OF HOLE 45°

BORE No 7

SHEET 3 OF 3

AZIMUTH 145°

Depth m	Description of Core	Degree of Weathering	Graphic Log	Discontinuities B - Bedding J - Joint S - Shear D - Drill Break	Rock Strength	Fracture Spacing (m)	Sampling & In Situ Testing			
							Sample Type	Core Rec. %	RQD %	Test Results & Comments
20.3	SANDSTONE - medium strength fresh slightly fractured light grey very fine grained sandstone									20.3
21	SILTSTONE - medium strength fresh to slightly weathered slightly fractured dark grey siltstone baked adjacent dyke			20.8m 090/subvertical undulating slickensided joint slicks plunge 70° to 090						1 Lu
21.2	DYKE - medium strength highly weathered fractured light grey dyke, possibly dolerite with some white blebs			within dyke 2 sets of joints both sub vertical parallel and perpendicular to the strike of dyke Joints are probably closed spaced ~0.1m			C	100	50?	Is ₅₀ (d)=0.5Mpa 5 Lu
22				21.2m and 22.4m vertical contacts between dyke and siltstone						22.65
22.4	SILTSTONE - low strength slightly weathered fractured dark grey baked siltstone			23.0m 050° subvertical smooth planar joint						12 Lu
22.9										
23	SANDSTONE - medium strength fresh slightly fractured light grey very fine grained sandstone			24.2m 050° subvertical smooth planar joints			C	100	95	18 Lu
24				24.5m 050° subvertical smooth planar joint						
24.4	SILTSTONE - low strength slightly weathered slightly fractured dark grey siltstone			25.25m 050° subvertical smooth planar joint						
25				25.5m 090/80° rough planar. 25.6m 050° subvertical joints						
25.7										
26	BORE DISCONTINUED AT 25.7 METRES									

RIG Scout

DRILLER Cooper

LOGGED

McMorran

CASING GL to 7.3m

TYPE OF BORING Roller bit from GL to 7.3m, then NQ coring to 25.7m

WATER OBSERVATIONS

REMARKS

SAMPLING & IN SITU TESTING

- A auger sample
B bulk sample
C core sample
PI point load strength $I_p(50)$ (MPa)
S standard penetration test
U U-tube dilatometer



D.J. Douglas & Partners

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Eastern Creek

Project No 14875
November 1992



PLATE 1: Distant view of dyke; Note that the dyke is barely perceptible within the surficial clay due to extreme weathering

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Eastern Creek

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November 1992

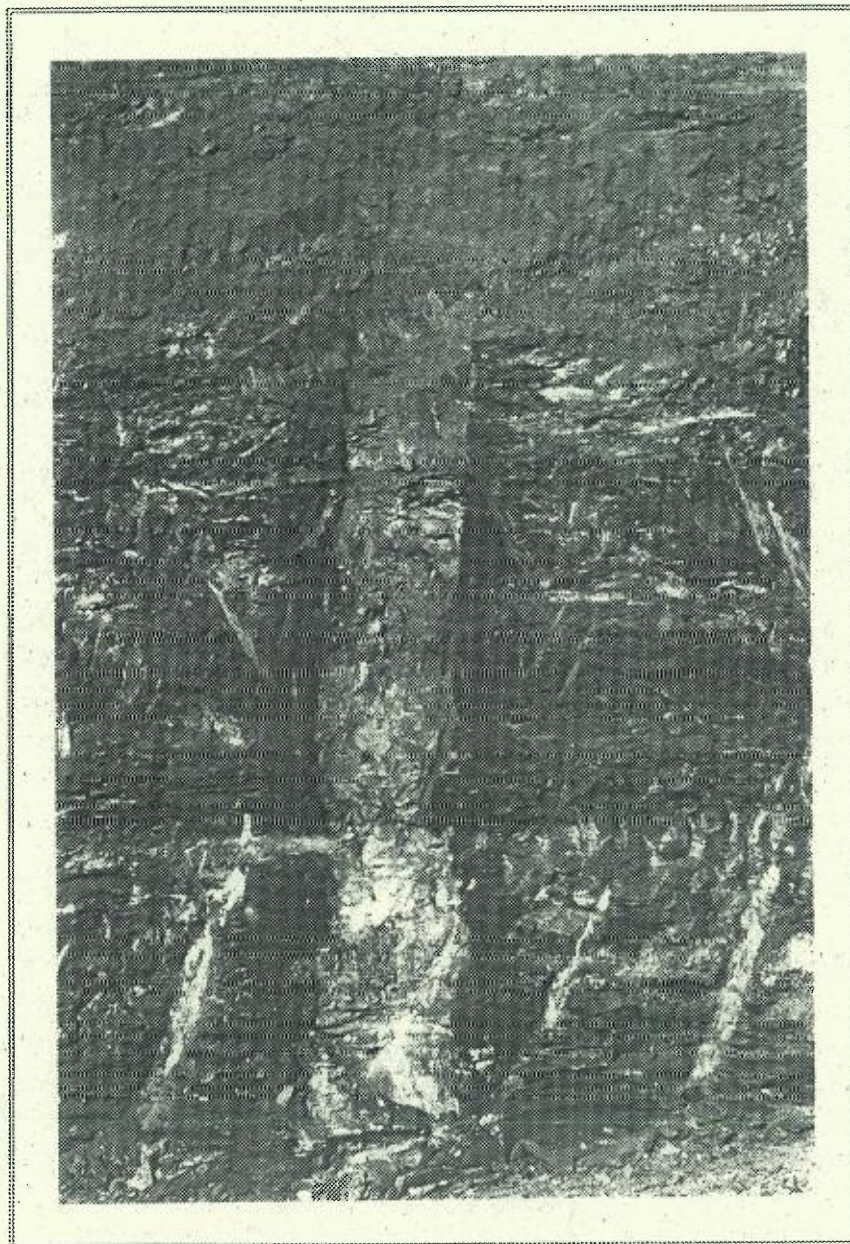


PLATE 2: View of dyke showing zones of dark grey 'baked' siltstone, metamorphosed by contact with dolerite, during intrusion of dyke

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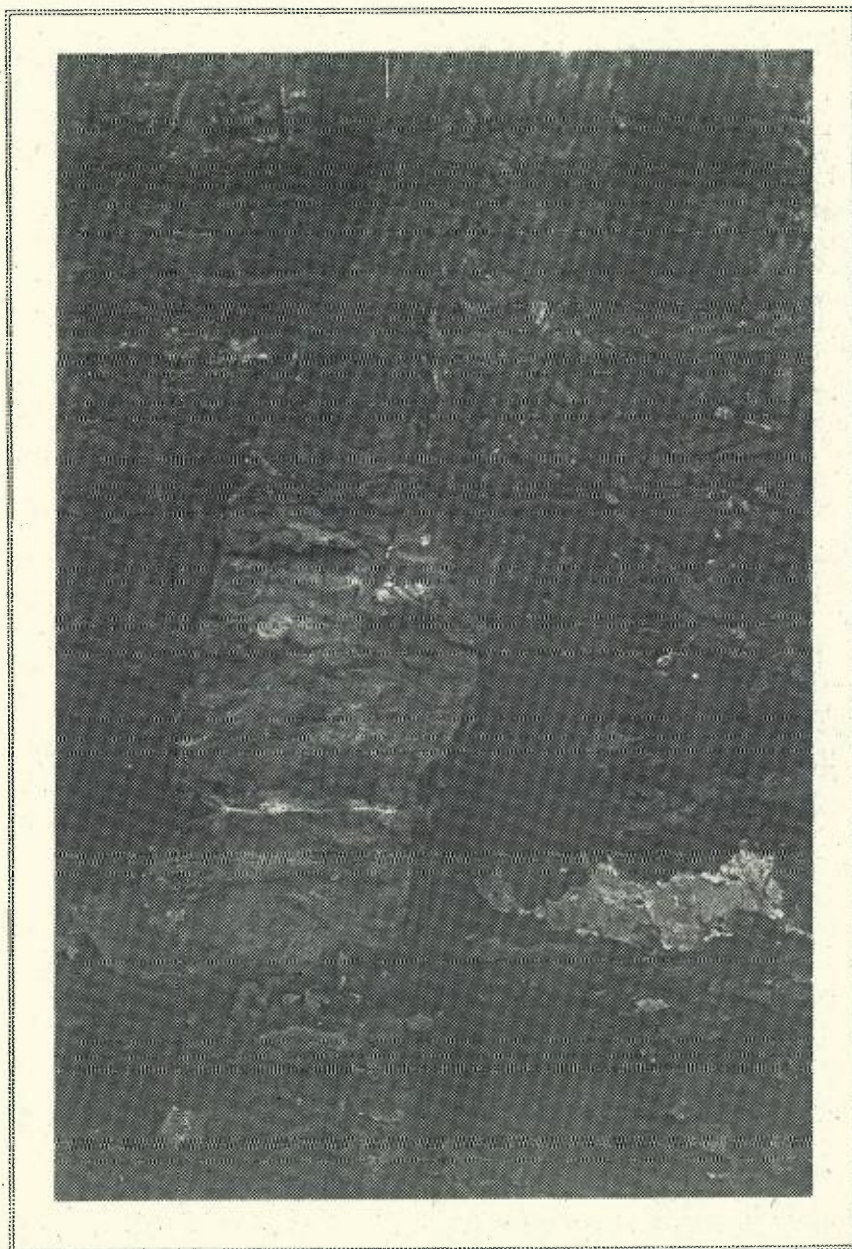


PLATE 3: View of dyke showing locally irregular contact
between dolerite and adjacent siltstone

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Project No 14875
November 1992

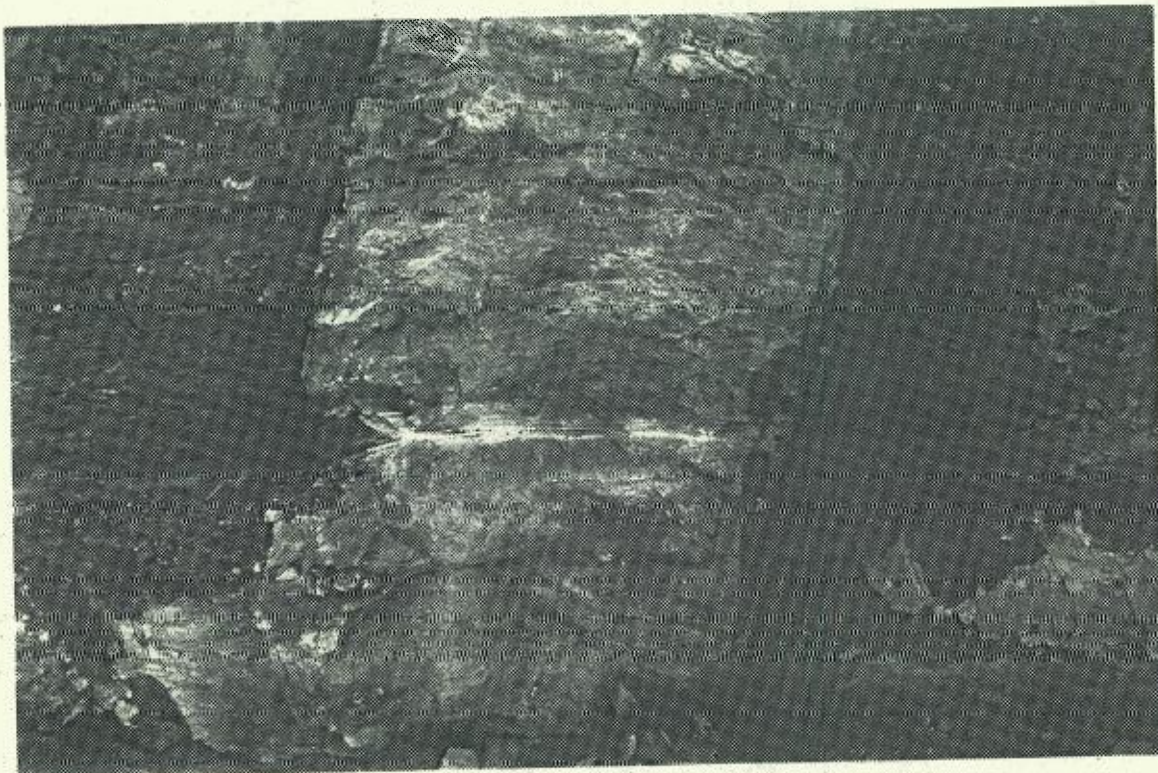


PLATE 4: Close-up view of dyke. Note: irregular contacts between dyke and adjacent rock and weathered horizontal fractures.

APPENDIX C

RESULTS OF PUMP RECOVERY TESTS

PUMP RECOVERY TEST ANALYSES

The pump tests performed as part of this study have been analysed after making several simplifying assumptions. The errors introduced by these assumptions should not be significant (maybe less than 20%) and will therefore not detract greatly from the information provided, particularly when the spatial variability in hydraulic characteristics of the aquifer are considered and hence the very real possibility that the tests are recording localised conditions rather than parameters representing a large region of the aquifer. Nevertheless, it is considered that the tests are of real value as they can be used to broadly classify the rock as being very low, low, moderate or high transmissivity.

The assumptions made in analysing the test data are:

- . the aquifer is fully confined.
- . the bores are fully penetrating. Clearly this has not been proven but the fact that they have been drilled into fresh, slightly fractured rock of much lower hydraulic conductivity than the overlying rock means that this assumption will not seriously affect the results.
- . the aquifer is homogeneous and isotropic. This is unlikely to be so over wide areas but should be approximately so within the area of influence of the test.
- . the pump bore receives water by horizontal flow. When total drawdown is almost equal to the depth of penetration of the bore, vertical flow components are inevitable.
- . storage of water remaining as a film on the walls of the bore at the completion of pumping can be neglected.

Analysis has been carried out by plotting residual drawdown as a function of log time and fitting a straight line to the data over one log cycle of time as proposed by Thies (1935). The slope of the straight line is:

$$\Delta s' = \frac{2.3Q}{4\pi T}$$

where $\Delta s'$ is the residual drawdown per log cycle of time

T is the transmissivity of the aquifer (m^2/d)

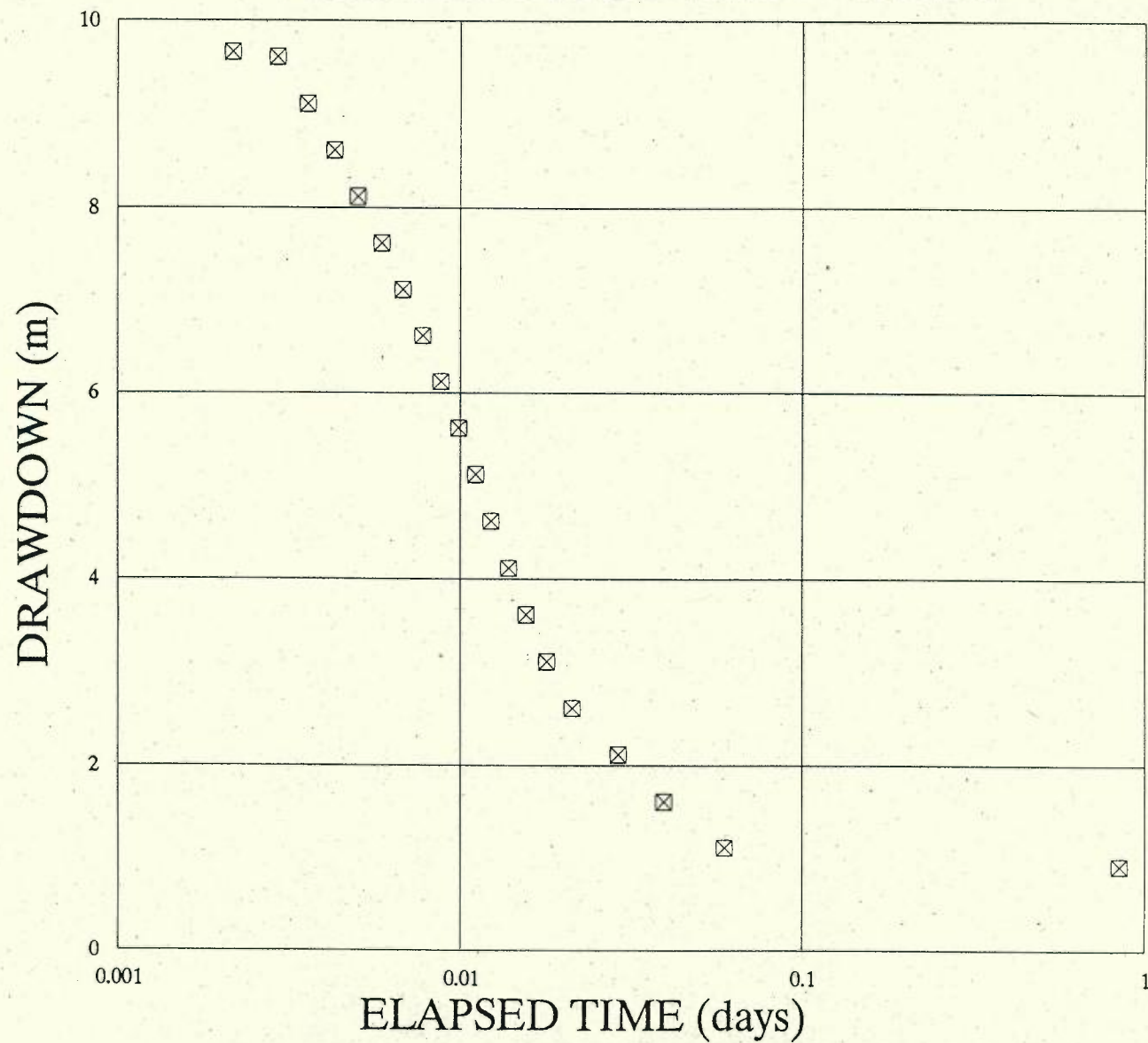
Q is the rate of recharge = rate of discharge (m^3/d)

from which the appropriate value of T can be calculated. Hydraulic conductivities given in Table 3 have been calculated from $T = KD$

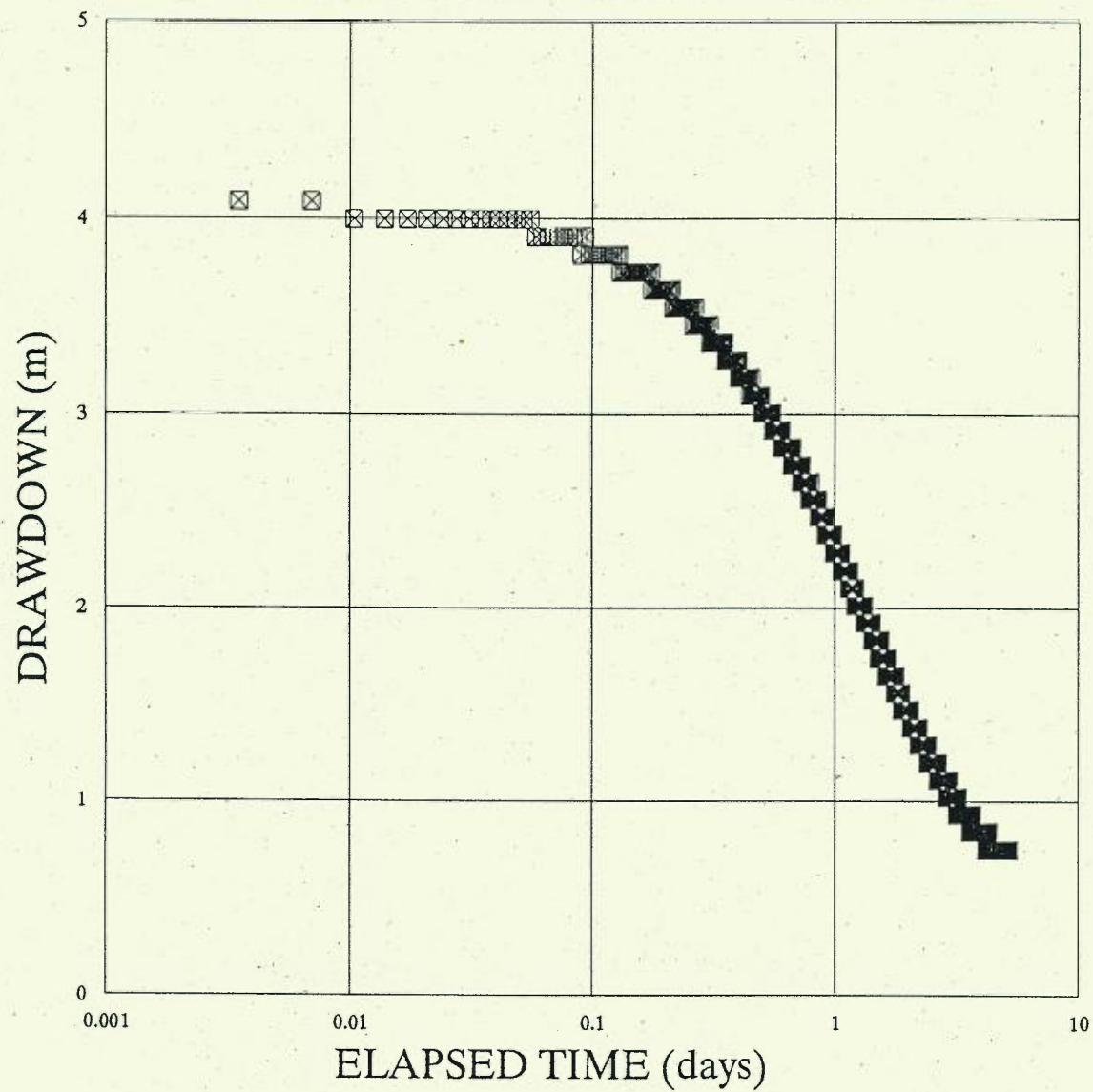
where K = hydraulic conductivity (m/S)

and D = the thickness of rock penetrated by the bores.

EASTERN CREEK REGIONAL WASTE DEPOT PUMP RECOVERY TEST – BORE 1



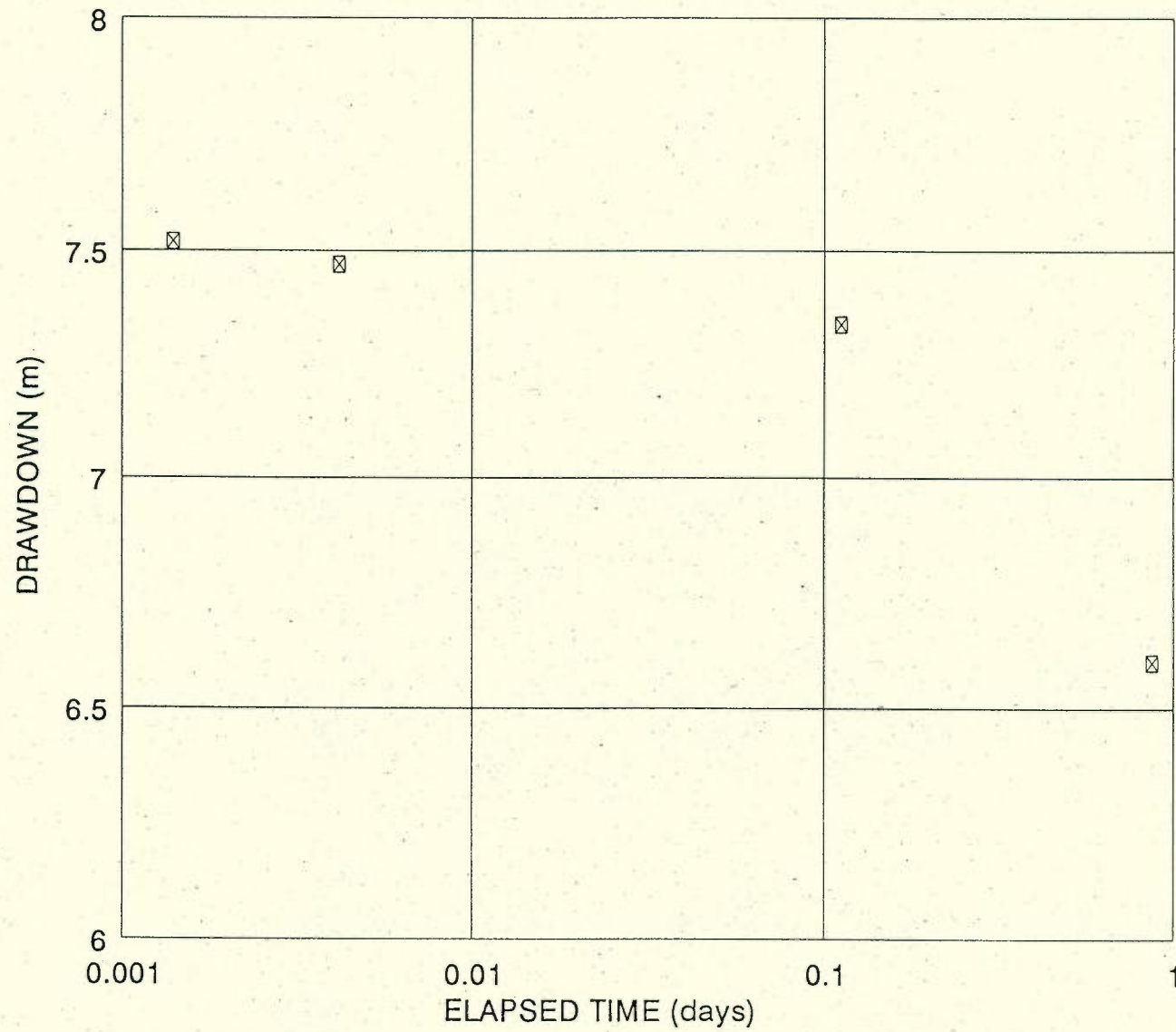
EASTERN CREEK REGIONAL WASTE DEPOT PUMP RECOVERY TEST – BORE 2



Φ

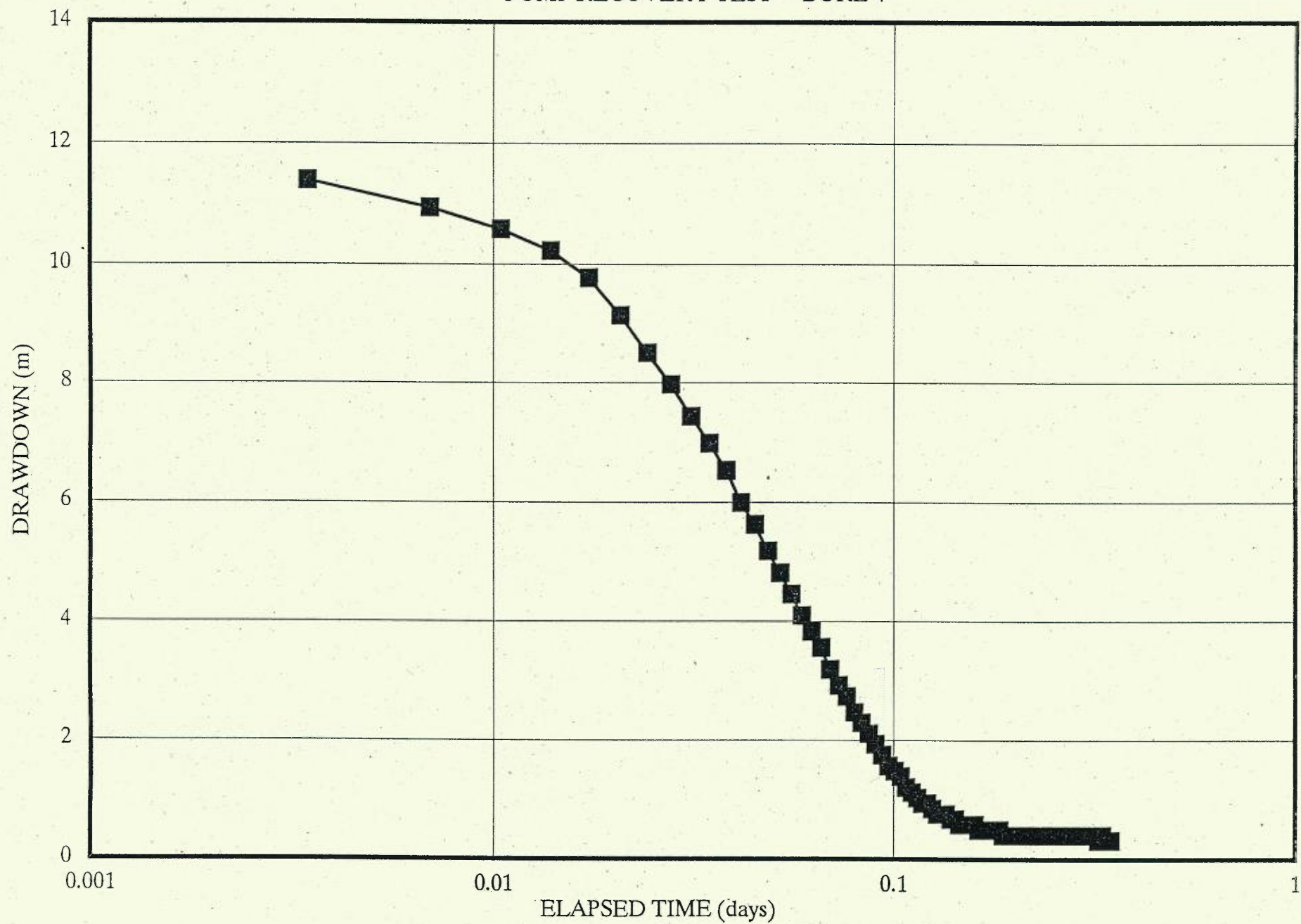
EASTERN CREEK REGIONAL WASTE DEPOT

PUMP RECOVERY TEST – BORE 3



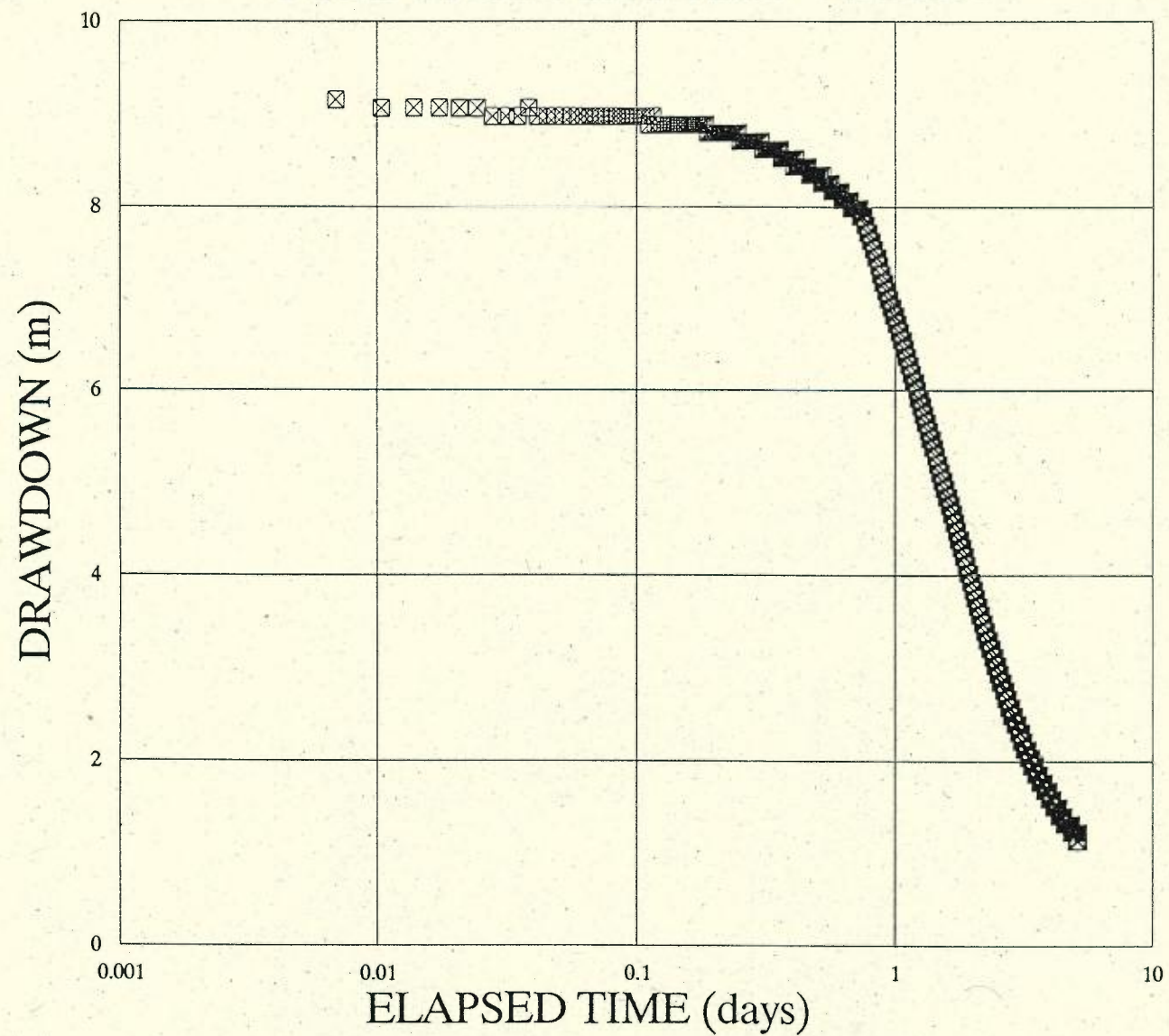
EASTERN CREEK REGIONAL WASTE DEPOSIT

PUMP RECOVERY TEST – BORE 4



⊕

EASTERN CREEK REGIONAL WASTE DEPOT PUMP RECOVERY TEST – BORE 5





PARAMETER	BORE 1	BORE 2	BORE 3	BORE 4	BORE 5	LIMITS#
Conductivity (mS/m)	1670	1200	1760	2030	890	
COD	263	172	241	358	119	
pH	7.3	7.2	7.3	7.1	8.3	
BOD5		Composite < 2				
Colour at 100 dilutions	N.D.	N.D.	N.D.	N.D.	N.D.	
Suspended Solids	20	5	8	11	3	
Total Dissolved Solids	I.S.	I.S.	I.S.	I.S.	I.S.	
Aluminium (Al)	0.6	1	1	1.3	0.8	
Ammonia (NH4)	2.6	1.1	2.9	3.4	1.1	0.5
Arsenic (As)	<0.01	<0.01	<0.01	<0.01	<0.01	0.05
Barium (Ba)	5.6	0.34	0.4	4.85	0.51	1
Boron (B)	0.02	0.02	<0.01	0.01	<0.01	1
Cadmium (Cd)	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Chromium (Cr)	<0.01	<0.01	<0.01	0.02	<0.01	0.05
Cobalt (Co)	0.01	<0.01	0.04	0.02	0.02	
Copper (Cu)	<0.02	<0.02	0.04	<0.02	<0.02	1
Iron (Fe)	2.44	0.53	0.54	0.77	0.37	0.3
Lead (Pb)	<0.1	<0.1	<0.1	<0.1	<0.1	0.05
Manganese (Mn)	0.53	1.5	0.62	1.03	0.27	0.05
Mercury (Hg)	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Molybdenum (Mo)	<0.05	<0.05	<0.05	<0.05	<0.05	
Nickel (Ni)	0.03	0.04	<0.01	<0.01	<0.01	
Selenium (Se)	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Silver (Ag)	<0.05	<0.05	<0.05	<0.05	<0.05	
Tin (Sn)	<0.1	<0.1	<0.1	<0.1	<0.1	
Zinc (Zn)	<0.01	<0.01	<0.01	<0.01	<0.01	5
Sulphate (SO4)	36	320	330	21	205	250
Sulphide	<0.05	<0.05	<0.05	<0.05	<0.05	
Sulphite + Thiosulphate	<0.5	<0.5	<0.5	<0.5	<0.5	
Chlorinated H'carbons	<0.01	<0.01	<0.01	<0.01	<0.01	
Cyanide - Total (CN)	<0.05	<0.05	<0.05	<0.05	<0.05	0.05
Formaldehyde (HCHO)	<0.1	<0.1	<0.1	<0.1	<0.1	
Grease (C16-C18)	I.S.	I.S.	I.S.	I.S.	I.S.	
Herbicides	<0.02	I.S.	I.S.	<0.02	I.S.	0.1
Mercaptans	<0.02	<0.02	<0.02	<0.02	<0.02	
Pentachlorophenol	<0.02	<0.02	<0.02	<0.02	<0.02	
Organochlorides	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Organophosphates	<0.01	<0.01	<0.01	<0.01	<0.01	0.05
Petroleum Hydrocarbon	<0.02	<0.02	<0.02	<0.02	<0.02	
Phenol	<0.03	<0.03	<0.03	<0.03	<0.03	0.001
PAH	<0.02	I.S.	I.S.	<0.02	I.S.	

N.D.=Not Detected
Clean Water Act

I.S.=Insufficient Sample

Above Limits