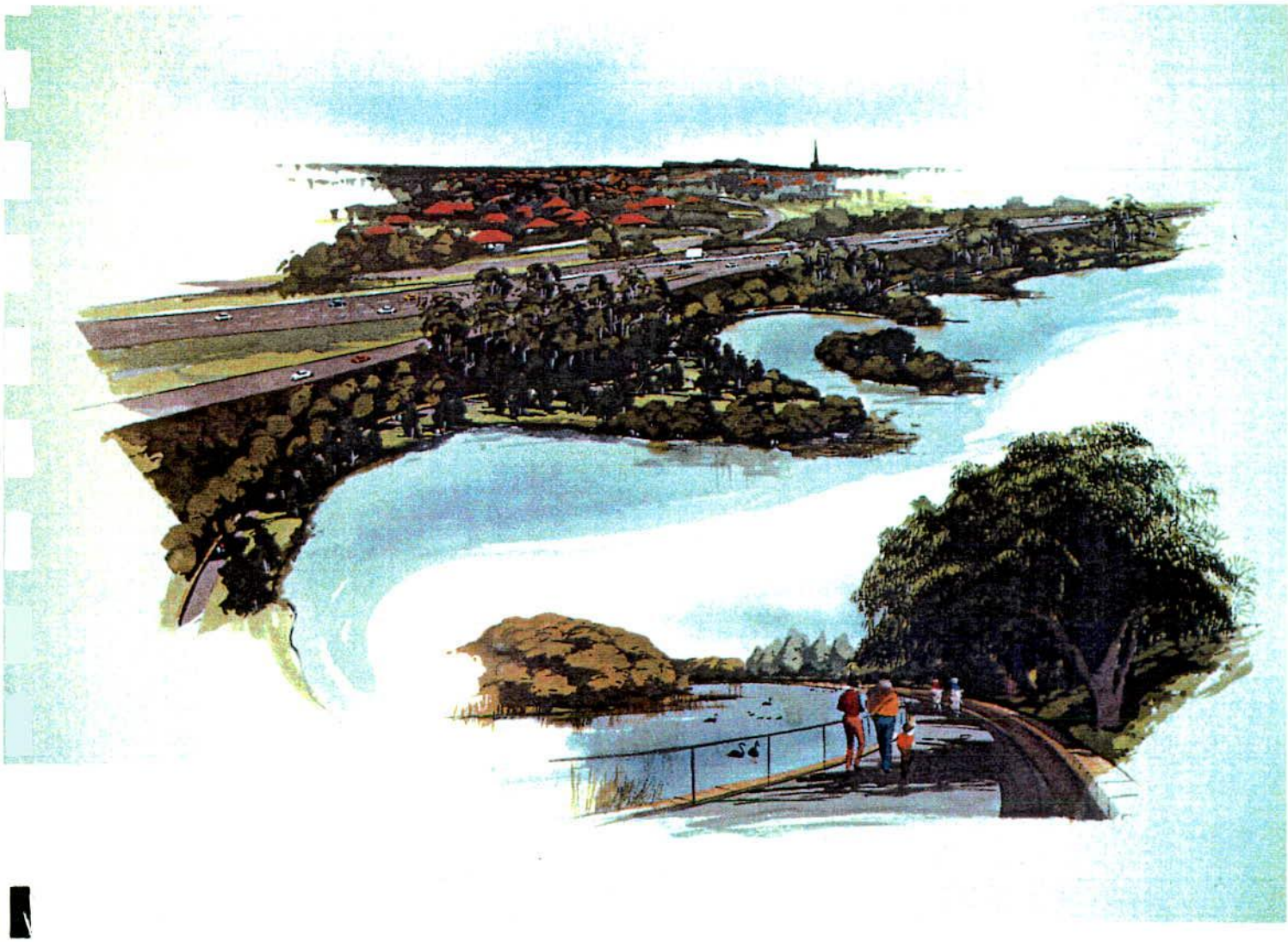
LANDFILL FOR FUTURE WIDENING OF THE MITCHELL FREEWAY AT LAKE MONGER



PUBLIC ENVIRONMENTAL REVIEW

Prepared by

DEPARTMENT

erth, Western Austalia, 6004

[BER 1989

PUBLIC ENVIRONMENTAL REVIEW

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal.

The Public Environmental Review (PER) for the proposed Landfill for Future Widening of the Mitchell Freeway at Lake Monger has been prepared in accordance with Western Australian Government procedures. The report will be available for comment for 8 weeks beginning on December 2 1989 and finishing on January 26 1990.

Comments from government agencies and from the public will assist the EPA to prepare an Assessment Report in which it will make recommendations to Government.

Following receipt of comments from Government agencies and the public, the EPA will discuss the issues raised with the proponent and may ask for further information. The EPA will then prepare its assessment report with recommendations to Government, taking into account issues raised in the public submissions.

The proposal deals with an intention by the Main Roads Department to preload an area on the eastern edge of Lake Monger with sand to improve the ground conditions for the proposed widening of the Mitchell Freeway. Filling and rehabilitation of a small portion of the lake edge is also proposed.

WHY WRITE A SUBMISSION?

A submission is a way to provide information, express your opinion and put forward your suggested course of action including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received will be acknowledged.

DEVELOPING A SUBMISSION

You may agree or disagree, or comment on, the general issues discussed in the PER or with specific proposals. It helps if you give reasons for your conclusions, supported by relevant data.

You may make an important contribution by suggesting ways to make the proposal environmentally more acceptable.

When making comments on specific proposals in the PER,

- clearly state your point of view
- ndicate the source of your information or argument if this is applicable
- suggest recommendations, safeguards or alternatives.

POINTS TO KEEP IN MIND

By keeping the following points in mind, you will make it easier for your submission to be analysed.

Attempt to list points so that the issues raised are clear. A summary of your submission is helpful. Refer each point to the appropriate section, chapter or recommendation in the PER. If you discuss sections of the PER, keep them distinct and separate, so there is no confusion as to which section you are considering.

Attach any factual information you wish to provide and give details of the source. Make sure your information is accurate.

Please indicate whether your submission can be quoted in part or full, by the EPA in its Assessment Report.

REMEMBER TO INCLUDE

YOUR NAME/ADDRESS/DATE

THE CLOSING DATE FOR SUBMISSION IS:

FEBRUARY 2 1990

SUBMISSIONS SHOULD BE ADDRESSED TO:

The Chairman
Environmental Protection Authority
1 Mount Street
PERTH WA 6000

ATTENTION: MR N WIMBUSH

TABLE OF CONTENTS

1 SUMMARY

This Public Environmental Review has been prepared by the Main Roads Department of Western Australia to explain proposed sand filling for surcharging of the section between Vincent Street and Powis Street on the west side of the existing freeway in preparation for future widening of the Mitchell Freeway between Hutton and Loftus Streets.

This section of freeway presently consists of only the southbound carriageway which serves as a two-way road. Construction of a northbound carriageway is necessary to allow for the proposed Northern Suburbs Railway which will runs along the freeway median from Perth to Joondalup. The Minister for Transport, Mr Bob Pearce, MLA has described the freeway widening as an integral part of the railway project which is to be operational by the end of 1992.

Lake Monger Reserve is used extensively as a recreational area for local residents and other visitors and the reserve is registered as an Aboriginal site of historical and mythological significance. It is an important urban wetland habitat for the Western long-necked tortoise, several species of frogs and a wide variety of birds.

Detailed design of the new carriageway is currently taking place. This document focuses on the environmental impacts associated with preparatory work necessary to improve ground conditions to a level of compaction suitable for road construction. The preferred proposal involves preloading the road reserve area, backfilling with sand fill a small section on the north-eastern edge of the lake, and subsequent landscaping of the new lake edge to retain and improve recreational and fauna and flora values. This proposed line of action has been established after careful consideration of many options of which six (6) alternatives were considered in detail. Of these alternatives only three (3) are feasible options which satisfy the concerns of the local and broader community. These are described as Alternatives 1 to 3 in the documentation. The Main Roads Department considers Alternative 1 provides the least environmental impact and most benefit to the community.

Extensive technical and environmental investigations by Main Roads Department have led to the preparation of sand fill and lake foreshore rehabilitation proposals which have no significant impact apart from the temporary visual impact caused by the requirement for surcharging to heights of up to 4.5 metres above the level of the freeway, dependent on the depth of underlying peat.

Landscape proposals for realignment of a small part of the lake foreshoreprovide improvements of the environmental quality of the lake and retain or improve all other recreational and flora and fauna values. These plans have been prepared in consultation with the Environmental Protection Authority and incorporated in the overall concept for redevelopment and management of the lake reserve as prepared and approved by Perth City Council.

The activities of the Main Roads Department and its appointed consultants and contractors are conducted at all times according to its Environmental Management Strategy. This pledges the Department, in managing the state road network, to take a balanced view by

considering all constraints and opportunities to provide the most efficient, safe and cost effective solution that minimises impact upon the environment.

All documentation referred to in the body of this report is available for public inspection at the Main Roads Department whose technical personnel will be pleased to respond to any queries. Written submissions from the public and other organisations in response to this PER will be reviewed by the Environmental Protection Authority which will present its recommendations to the Minister for the Environment.

2 NEED FOR PROPOSAL

The Western Australian Government is committed to the opening in 1992 of an electric rail system to service the northern suburbs of Perth. The rail line will run in the middle of the Mitchell Freeway with two separate carriageways on either side for north and southbound traffic.

This will necessitate the widening of the Mitchell Freeway for about six (6) kilometres between Loftus and Hutton Streets to accommodate the Northern Suburbs Railway and to improve the traffic flow for motorists (See Figure 1). At present, this section of the freeway consists only of the southbound carriageway. Since construction just over 10 years ago, the southbound carriageway has been used as a two-way road with no breakdown shoulders and only a nominal crash rail separating the two traffic flows.

Planning for the Mitchell Freeway has always been on the basis that a second carriageway would be constructed within the existing road reserve.

Early construction of the second carriageway is now required because of the State Government decision to locate the Northern Suburbs Railway within the median of the freeway. In order to meet the timetable for the construction of the rail system, the Main Roads Department requires to commence work in early 1990 on surcharging of the existing road reserve and lake foreshore to improve ground conditions to the levels of compaction necessary for road construction. All the surcharge areas are included in the freeway reserve.

However, in the north eastern quadrant of the lake, the waterway area extends into the freeway reserve and reclamation is required for the embankment slope. Additional reclamation outside the freeway reserve is preferred to relocate the dual use path and re-establish the foreshore vegetation.

The majority of land required for this work is owned by or vested in the Main Roads Department and is reserved in the Metropolitan Region Scheme for ultimate freeway development as two separate carriageways.

The northbound carriageway will be constructed within the existing road reserve which at Lake Monger, extends across the lake foreshore and slightly into the lake (See Figure 2). Ground conditions indicate a fairly consistent presence of peat and some old sanitary landfill which requires consolidation by compaction with sand fill for a period of up to 12 months before road construction can take place. The extent of the area to be treated is shown at Figure 3.

Consideration has been given to excavation of the peat and sanitary landfill, but this proved not to be a viable option due to the high cost and more particularly, the unpleasant nature of such operations for the workforce, residents and passing motorists.

3 ALTERNATIVES CONSIDERED IN THE DEVELOPMENT OF A PREFERRED OPTION

In selection of the preferred option to redevelop the Mitchell Freeway in the vicinity of the north east quadrant of Lake Monger the Main Roads Department has produced six (6) alternative road alignments and associated lake foreshore arrangements. The impacts of each alternative are discussed in Section 6. The requirements of the individual alternatives are described below.

3.1.1 Alternative 1

This option provides for widening of the freeway to the west of the existing alignment. The widening maintains consistency of lane width to current standards and provides for the provision of breakdown lanes and a central median to a width of 21 metres to accommodate the Northern Suburbs Railway and its service requirements in the vicinity of Lake Monger. This alternative requires some filling of the present waterbody for road construction purposes and includes a proposal to carry out additional filling to provide landscape and habitat enhancement of the adjacent lake foreshore. Alternative 1 is shown at Figure 4 with a an artists impression of the final product at Figure 5.

The additional landscape enhancement proposed has been developed in consultation with the City of Perth and are complementary to the overall concept for enhancement and management of the lake reserve as approved and prepared by the City of Perth. Lake reclamation beyond the road reserve is required to relocate the dual use path and re-establish the foreshore vegetation. This alternative also provides for maintenance of the current "sense of place" which exists in this section of the lake foreshore.

3.1.2 Alternative 2

This proposal is similar to Alternative 1. However lake reclamation is confined to the section of Lake Monger within the road reserve. This alternative is diagrammatically represented at Figure 6.

To accommodate a dual use path modification of the batter slopes between the road and path will require stone pitching of the 45 degree slopes. This will result in some loss of "sense of place" on the lake foreshore due to the proximity of the road and the lack of vegetation in the area.

3.1.3 Alternative 3

This option restricts freeway widening and associated redevelopment of the dual use path to areas up to but not including the lake foreshore. This alternative is diagrammatically represented at Figure 7 with an artists impression of the final product at Figure 8.

To accommodate all required facilities it is necessary to construct a retaining wall of some four (4) metres in height in sections closest to the lake edge to meet the minimum required standards for the road alignment. This would then be joined to the landscaped areas of the foreshore by stone pitching on the steep batters, similar to that described in Alternative 2.

3.1.4 Alternative 4

To provide a landscaped foreshore with a similar "sense of place" as presently exists, without any landfill of the waterbody of the lake, requires a complete alteration to the freeway layout in its relationship with Powis Street. This alternative is diagrammatically represented at Figure 9.

The achievement of this objective requires the freeway to be placed under Powis Street, rather than over Powis Street as is currently the case. This requires the existing freeway bridge and associated roadways to be demolished.

3.1.5 Alternative 5

This alternative requires the realignment of the freeway to the east of the existing carriageway, and retention of existing values between the freeway and the lake foreshore. However to complete the project requires the resumption and demolition of at least 25 residences and a church and modifications to the velodrome. This alternative is diagrammatically represented at Figure 10.

To complete this alternative the Northern Suburbs Rail project would not be completed prior to the end of 1992.

3.1.6 Alternative 6

This alternative maintains the lake edge by reducing the rail reserve requirement to an absolute minimum, thus prohibiting vehicular movement along a 2.5 kilometre section of the rail system for track maintenance. This alternative is diagrammatically represented at Figure 11.

Pedestrian access around the lake would be via a boardwalk placed over the water at the edge of the lake. A 3.5 metre high retaining wall would be required to accommodate the road embankment.

3.1.7 Other Alternatives

Other alternatives which are available to locate the rail system through this section include the options of:

- tunnelling to construct the rail below exist ground levels either between the existing freeway carriageways or outside the freeway structure,
- construction of the rail system on an elevated viaduct, and
- construction of the railway to the west or east of the existing freeway.

All these alternatives are more costly than the alternatives described above and have engineering difficulties to preclude there further consideration. It is considered the environmental and social impacts of these alternatives would include some or all of those established in Alternatives 1 through 6.

As a result these options have not been considered beyond the initial planning stages of this project.

3.2 Preferred option

Having evaluated all the options the Main Roads Department considered Alternative 1 to be the preferred option. This option provides the best balance of environmental, social, economic and engineering needs as the alteration made to the environment in the vicinity of Lake Monger maintains existing social values of the lake environs, improves the quality of the lake and its foreshore and allows for widening of the freeway to fulfil the broader community requirements for transportation along the freeway route.

Alternatives 2 and 3 are acceptable alternatives should the public review of this proposal not concur with the preferred option of the Main Roads Department. However both have disadvantages, particularly in the loss of social values which are not reflected in Alternative 1 and, in the case of Alternative 3, additional economic costs.

The Main Roads Department considers the additional costs, loss of assets and social disruption associated with Alternatives 4 and 5 suggests these alternatives are unacceptable alternatives.

The restrictions on access to the rail system for maintenance purposes and the additional safety structures required indicate Alternative 6 is not acceptable either to the authorities involved or the travelling public.

4 EXISTING ENVIRONMENT

Main Roads Department has carried out extensive investigations in the vicinity of Lake Monger to determine:

- ground conditions for roadwork construction (refer Section 4.1)
- groundwater quality and effects of leachate into the lake (refer Section 4.2)
- the impact upon the tortoise population of the lake (refer Section 4.3).

Reference to data relating to the quality of the water body at Lake Monger and social importance of the lake environs has been completed based on studies carried out by post-graduate students at Murdoch University and research staff from that institution. This enables some judgement to be made on the relative biological importance of the waterbody and its social significance (refer Sections 4.2 and 4.4).

In addition, the Department has worked in close liaison with Perth City Council to ensure the significant recreational value of the foreshore is retained. City of Perth staff have prepared an overall concept for redevelopment and management of the Lake Monger Reserve which has been approved by Perth City Council and incorporates the Department's proposals for realignment of the eastern boundary of the lake edge and landscaping of the foreshore and road reserve (refer Section 4.4).

Full consideration has also been given by the Department to its obligations under the Aboriginal Heritage Act with regard to the affected land area being registered as an Aboriginal site (refer Section 4.5).

4.1 Ground Conditions

Investigations carried out by consultants for Main Roads Department determined a fairly consistent picture of the presence of peat up to 4 metres thick and sanitary landfill up to 2 metres thick on the northern carriageway alignment between Vincent Street and Powis Street (Golder Associates, 1985).

Assessment tests were determined by:

- ollection and review of MRD data obtained during investigation for the first carriageway
- performance of 30 probes at selected locations using an electric friction cone penetrometer
- drilling of two bore holes and installation of slotted PVC casing to enable sampling of groundwater
- probing with a Perth penetrometer in the swampy area which bounds the western wide of the freeway at about chainage 6200.

Golder Associates concluded from these tests that the thicknesses of peat and land fill were not significantly different from those found during design of the first carriageway of the freeway, with the worst area, in engineering terms, located at the south east corner of Lake Monger, with about 2 metres of landfill overlying 4 metres of peat. The land fill sites are not considered to be of historical significance.

Unless treated in some way, peat and sanitary landfill make unsatisfactory foundations for railway or road embankments. They settle excessively and provide inadequate bearing capacity if the cover of the sand over them is thin.

The options for foundation improvement treatments include:

- stone columns
- dynamic compaction
- surcharge preloading
- excavation and replacement
- geotextiles

A descriptive summary of these options is attached as Appendix A.

Except for excavation and replacement, some post construction settlement occurs over peat and sanitary landfill regardless of which treatment is used. The Main Roads Department examined these various options and determined that surcharge preloading was the most suitable treatment for this area based on effectiveness, technical feasibility, economics and available time (MRD Materials Report 89/41M, 1989).

Surcharge preloading involves placing an additional load on the soft soil for a long period (in this case, 12 months) to accelerate the settlement so that it is substantially complete before the final structures of road pavements and rail track are constructed. This option is effective on peat and sanitary landfill.

4.2 Groundwater Quality

Data has been collected relating to groundwater quality and the possible effects of leachate into the lake. Water samples were collected from two representative bore holes drilled adjacent to Lake Monger and from the lake itself. (Golder Associates, 1985). A summary of the test bore hole results is included as Appendix B.

The most important feature of the results is the similarity of water quality between samples tested. It is noted the water sampled from peat and landfill material has considerably less nutrient content than that sampled from the lake. As nutrient content of the lake water is a major management issue it is not considered any leakage of water from the peat and landfill into the lake will adversely affected existing values of water quality (Dr J Davis, Murdoch University, pers. comm.). The general water quality of Lake Monger is very poor in relation to other Metropolitan wetlands but does not appear to detract from its social value (EPA, 1989a). Based on information collected, there would be minimal environmental change associated with any groundwater movement that might accompany freeway construction.

4.3 Tortoise Population

Studies of the Western long-necked tortoise (Chelodina oblonga) were conducted in 1987 by a team of scientists led by Dr Barbara Porter under sponsorship of the Main Roads Department (Fauna Survey and Tortoise Study Interim Report, 1987). The team paid particular attention to the fact that female tortoises were being killed on the adjacent roads as they moved across the roads in the breeding seasons.

Evidence has also shown that domestic and introduced animals, for example, dogs and rats, were destroying some of the tortoise nests.

Because Lake Monger has been markedly influenced by settlement, the tortoise population is unique. The water level in the lake is artificially maintained and the tortoises breed for a large part of the year compared with most wetlands where the breeding season is usually restricted to two short periods in August/September and December.

The tortoises were found to be an important element in the control of midges, consuming at Lake Monger more than one tonne of midge larvae per month.

The study team concluded that:

- The reed bed at Lake Monger is a valuable resource to birds, tortoises and frogs and should be preserved for reintroduction to new areas
- While there is a large tortoise population in the lake, males outnumber females and female numbers were being further depleted by road deaths when they leave the water to lay their eggs
- Tortoises could learn to use protected sites on an artificial island or an area near the shore where their movements could be channelled and protected by low fences
- Any fences would need to be well planned to divert the females to preferred safe areas and not trap them which could lead to dehydration or predator attack.

These aspects have been incorporated in the landscape proposals developed in association with Alternative 1 (Refer Section 3.1.1 and 6.4.1).

4.4 Social Values and Public Use of Lake Monger Environs

Middle, 1988 discussed the social importance of Lake Monger as part of a case study of the social importance of lenthic wetlands (those associated with standing water). In the study residents living adjacent or near the lake listed the aspects liked most about living near the lake as described in Table 1.

The number of residents questioned was 59, selected at random from houses within one (1) kilometre of Lake Monger. Each house was visited in the late afternoon on a weekday or on a Saturday during the month of December.

The major dislike of close proximity to the lake was midges, with 57.1% of those surveyed expressing this dislike. Another 26.5% disliked nothing about the lake.

CHARACTERISTIC	% RESPONSE
View	49.0
Quiet	12.2
Natural Areas	12.2
Birds	18.4
Other Wildlife	6.1
No Houses Visible	8.2
Convenience	26.5
Open Water/Space	18.4
Cycleway	4.1
Nothing	2.0
Parkland	14.3
Other	10.2

TABLE 1: Desirable Aspects of Lake Monger for Residents

Most residents with a view found it very pleasing, these representing 60% of those people questioned. When changes to the lake where considered 63.3% of residents expressed a desire for no change with passive recreation and wildlife conservation seen as most acceptable changes. The lake facility was seen as a positive factor in the decision to live in the area by 70% of residents and it was seen to add value to their property by 64.3% of surveyed residents.

When questioned on their individual use of the lake area the response was as tabled below:

RESIDENTS ACTIVITIES	% RESPONSE
Walking 73.5	
Cycling	26.5
Running	8.2
Exercise pets	8.2
Kids playing	22.4
Ball games	8.2
Sit and relax	12.2
Picnic/barbecue	4.1
Enjoy the scenery	10.2
Feed the Birds	18.4
Observe the birds	8.4
Do not visit	2.0

TABLE 3: Activities of Individuals at Lake Monger

The survey identifies the value of the lake to residents to include at least one of the following:

- its aesthetics,
- .as an attraction in their choice of where to live,
- value it adds to local real estate, and
- as a place to visit for recreation.

A survey of users of the lake area by Middle indicates the weekly visitation to Lake Monger is in excess of 12 000 visitors. On a usage comparison this is approximately two times the weekly concentration of usage as Centennial Park in Sydney (NSW). A breakdown of the activities of individuals is tabulated below.

ACTIVITY	% PARTICIPATION WEEKDAYS	% PARTICIPATION WEEKENDS
Picnic	8	9.2
Sit and Relax	8	17.7
Sitting in Car	16	2.2
Feed the Birds	23	10.6
Observe Birds	10	8.2
Photograph Birds	14	0.7
Photograph Selves	12	0.6
Use Playground	12	21.4
Play on Grass	1	3.1
Collect	0	0.2
Walk	25	17.0
Run	14	3.6
Cycle	16	5.5
Exercise Pets	4	2.0
Bird Contact	32	19.4

TABLE 3: Activities of Individuals at Lake Monger

From these surveys it can be seen the activities of individuals were not singular but often accommodated more than one leisure pursuit.

The most popular area at Lake Monger is the area adjacent to Dodd Street to the north end of the lake. This may be due to

- provision of facilities which are new and in good condition,
- the area is open with plenty of room to sit and play, and
- the relative quiet of the area due to the absence of adjoining busy streets.

4.5 Lake Monger Reserve Management

Lake Monger Reserve consists of 69 hectares of open water with an island of 1.3 hectares in the south western corner. The Mitchell Freeway forms the eastern boundary of the reserve and separates Lake Monger from East Leederville and Mount Hawthorn. The lake is an important visual resource as it is viewed by motorists from the freeway and surrounding streets and also by residents in adjacent suburbs.

The area is managed by the Parks and Gardens Department of Perth City Council. Recreational activities currently carried out on the Reserve on a regular basis are walking, jogging, cycling, exercising of dogs, bird watching, feeding of birds, playing on playground equipment, picnicking in cars overlooking the lake, picnicking, barbecuing, sight seeing, kite flying photography, skateboard riding, model yacht racing and some athletics and team sports training.

Construction of the freeway and freeway reserve by the Main Roads Department created recreational access to the eastern edge of the lake with inclusion of a dual use path which now provides cyclists, walkers and joggers with circumnavigation of the lake.

4.6 Aboriginal Site

Lake Monger and its foreshore is a registered Aboriginal site known to have been used as a pre-contact camping, hunting and fishing site.

Main Roads Department, as owners of a portion of the land, has lodged notice with the Western Australian Museum under Section 18 of the Aboriginal Heritage Act requesting use of the land required including that section vested in the City of Perth, with the agreement of the City. This proposal has been investigated by the Aboriginal Cultural Materials Committee of the Museum and the Committee resolved to the Main Roads Department carry out discussions with the relevant Aboriginal people with interests in the area to establish the significance of the proposed works and submit a report on the outcome of the discussions.

Some preliminary discussion with members of a group of Aboriginal people affected indicates some objection to any disturbance of the water body of the lake and its immediate surrounds. Until full and frank discussion is complete with all members of the affected Aboriginal people the overall impact of this project on their interests cannot be determined.

Resolution of these issues and submission of a final report to the Aboriginal Cultural Material Committee will be conducted in parallel with the public review process provided by this Public Environmental Review.

5 PROJECT DESCRIPTION

This Public Environmental Review focuses on the proposal for preparatory work between Vincent and Powis Streets which embraces:

Ground preparation, including placement of fill and any realignment of the Lake Monger foreshore adjacent to the freeway reserve.

Rehabilitation and landscaping of the reserve, lake foreshore and lake edge dependent on the alternative for widening the freeway which is adopted.

The alternative preferred by the Main Roads Department is Alternative 1 described at Section 3.1.1. The impacts, including those which affect the local and regional environment, engineering factors, costs associated with each alternative considered and social values associated with the lake and its environs, have been considered to produce a result which is the best balance to provide the minimum impact on all values.

The proposed roadworks affects only the eastern edge of the lake reserve. where filling and reshaping of a small portion of the lake will result in beneficial impacts considered by the Main Roads Department to outweigh the small reduction in lake area. The reclamation area of the lake based on high water shore line is 9150 square metres or 1.3 per cent of the total lake area of 69 ha. The creation of an island measuring approximately 50 x 20 metres at water level and new shore line as a refuge and food resource for aquatic animals and birds is considered of major benefit in lieu of the small area of lake required for reclamation.

As stated above, the ground conditions adjacent to Lake Monger require preparation by consolidation because of the presence of substantial levels of peat and sanitary landfill.

It is proposed to preload with sand fill for a period of up to 12 months to a surcharge height of up to 4.5 metres above the existing freeway, dependent on the thickness of the underlying layer of peat (See Figure 3). The surcharge will be placed on the ultimate alignment of the freeway which is established following public consideration of this proposal.

Approximately 400 000 cubic metres of fill is required, the bulk of this material being clean yellow sand available north of Ocean Reef Road. The Main Roads Department proposes to let a contract for the transport of fill from excavations at the northern extremities of the Mitchell Freeway. It is proposed that the transport of this material would commence in late February 1990 with completion of preloading to heights of up to 4.5 metres above the existing freeway level within six months. The settlement period would be a maximum of 12 months.

Standard departmental management procedures will apply in the selection and management of the sites and the transport of the material in respect of dust control and placement noise levels (Refer 6.1).

The department has arranged for detailed plans to be prepared for the rehabilitation of the lake foreshore including creation of a new artificial island for tortoise breeding, realignment of the foreshore dual use path, extensive planting of the foreshore, island and road reserve, and construction of road reserve fencing (see Figs 5, 12, 12A and 13).

6 ENVIRONMENTAL IMPACTS AND MANAGEMENT

Irrespective of the alternative selected a number of impacts are common to all scenarios. These relate to the transport and placement of material for surcharging and any possible deterioration of water quality of the lake as a result of groundwater infiltration.

6.1 Surcharging

The extent of surcharging is detailed in Figure 3. Approximately 400 000 cubic metres of sand fill is required and will reach to a height of up to 4.5 metres above the level of the existing freeway. This will result in a temporary visual impact for viewers of the area from both adjacent suburbs and from the freeway.

Standard management control measures will apply as follows:

- Transport of surcharge material: trucks hauling material over public roads will be fitted with tight tailgates and loaded with adequate freeboard of not less than 75 mm without precarious cones or piles of material. Covers will also be used to prevent generation of dust in transit to the site.
- Dust control for surcharge sites: surcharge sites will be watered as required during construction to control dust. At the completion of surcharging, these areas will be hydromulched.
- Noise control: transport contractor hours will normally be restricted to standard hours of work i.e 7 am to 6pm. The exact hours and decisions on weekend work will be partly dictated by construction timing constraints according to road construction design parameters now being investigated.

6.2 Consolidation Leachate Entering Lake Monger

As stated in Section 4.2, the amount of water displaced by consolidation will not significantly affect water quality in Lake Monger (Golder Associates, 1985).

This conclusion is based on the fact that:

- .the sanitary land fill consists of predominantly sandy consolidation to achieve tolerable post-construction settlements, has similar water quality to that of the lake.

Stormwater drainage of the freeway pavement will be subject to detailed design currently underway. Cutoff drains may be required to prevent discharge of silt into the lake during surcharging. The Main Roads Department will maintain liaison with the Water Authority of Western Australia during design stages of the overall project and these aspects will be subject to regular monitoring during construction stages.

6.3 Public Access to Eastern Foreshore Area of Lake

During the process of establishing the surcharge for preloading of the freeway foundation it is proposed to stage works to provide continual public access to around the eastern side of Lake Monger. This will provide for use of a dual use path within the works area to allow

the public to travel along the pathway with some restriction to access to the actual lake foreshore in the area of the works while the necessary structures are put in place to provide for the final access route.

During the construction period the standard of surface and the elevation of the path will differ from the present path characteristics. To allow access to the filled areas it will be necessary to construct inclined and declined sections to negotiate the work area. There may be some minor interaction with construction vehicles during construction which could result in some delays in travel along the dual use path. The path surface is proposed to be constructed of a crushed limestone during the period of construction. The path alignment may also vary throughout the construction period.

6.4 Recreational and Wildlife Values

The objective of impact management proposals put forward in this document is to develop the proposal to widen the freeway in such a manner as to maintain the present day values of the Lake Monger area as a minimum objective, with best use being made of opportunities to enhance the lake environment. Each of the alternatives proposed in Section 3 has specific impacts and management needs.

6.4.1 Alternative 1

This option includes the creation of an island to facilitate tortoise breeding, transplantation of the lake edge reeds, relocation of the dual use path, creation of tortoise proof fencing and secure breeding habitats and extensive planting of native shrubs, trees and ground covers.

The widening of the freeway and associated landscaping intrudes into Lake Monger near Powis Street and will require the reclamation of approximately 9150 square metres of the lake and removal of foreshore vegetation over a length of 350 metres. The island and new shoreline will need to be overlain with a layer of clean river sand.

This proposal has been accepted by Perth City Council as in line with Council's Development and Management Concept Plan for the Lake Monger reserve. The provision of protection features for tortoises and other wildlife together with realignment of the dual use path will enhance recreational facilities in keeping with the City Council's desire to provide improved facilities for local residents and other visitors to the lake reserve.

It is accepted that this option changes the visual perception of the lake compared to the present situation. However it is considered to maintain the "sense of place" of the lake, particularly as the northern end of the lake is the most used area (Middle, 1988) and usage is the result of the distance from main traffic routes and the space available. It also insulates the users of the dual use path from the bustling movement of the freeway traffic to allow an appreciation of the peaceful lake setting and its wildlife.

The lake is of interest to the Aboriginal people in both an ethnographic and archeological sense (O'Connor et al 1985, Brown 1983).

Creation of the habitat island and increasing the shoreline will improve wildlife conservation in this section of the lake and associated onshore structures should reduce the potential for roadkills and feral animal predation which now exist. The placement of the island and foreshore design has been developed to ensure circulation of water in the area and eliminate the potential for "dead water" between the shoreline and the island.

The high nutrient levels in the water of the lake may be assisted by the nutrient uptake of the plantings proposed for the new foreshore and the island, particularly in the area immediately around the treated area.

The detailed landscape plans prepared by consultants on behalf of the Main Roads Department require an optimum sequence of operations if order to preserve aquatic life and maintain access around the lake for cyclists and pedestrians. The proposed sequence involves:

- installation of mesh fence in lake 5 - 10 metres offset from proposed new lake edge;
- translocation of tortoises and other aquatic life to other side of fence;
- creation of an island approximately 50 x 20 metres at water level and of a new lake edge;
- removal and temporary storage on site (if necessary) of reeds for translocation to new shoreline and island edge (the ideal operational time is Autumn but it is possible at other times with reticulation):
- completion of earthworks between existing dual use path and transplantings along shoreline;
- installation of new path on final alignment;
- installation of new boundary fence on final boundary;
- installation of surcharge for ramps and carriageway.

Landscape proposals are as detailed in Figures 12 to 14. The complete report (Blackwell & Associates, 1987) is available for inspection at Main Roads Department.

6.4.2 Alternative 2

This option restricts landfilling to the existing road reserve but requires the filling of some 850 square metres (or 0.1%) of the water body of the lake. The reduction in landfill area does not affect the freeway alignment, however it limits any redevelopment of the foreshore and removes the possibility of ameliorating the aesthetic intrusion of the freeway on the lake environment. This is significant in view of the resident's opinions on the value of the lake to their quality of life.

A new lake edge would be created along the road reserve boundary using techniques similar to those described for Alternative 1. This does not include creation of a habitat island.

The steep batter which would be required between the dual use path and the freeway would require stone pitching to stabilise the slope. Guardrailing immediately adjacent to the edge of the freeway would provide a barrier between the dual use path and the roadway.

The volume of sand required to complete this option is less than that required for alternative 1.

Cost savings through reducing the landfill area and associated landscaping are balanced by the need for stone pitching and guardrailing, thus no significant difference in cost to Alternative 1 is predicted.

6.4.3 Alternative 3

This alternative, and those which follow it require no landfilling of the water body of the lake.

To accommodate this change, modification is required to the existing southbound carriageway which alters the line of the kerb and requires some widening of this carriageway to the east to accommodate the minor realignment. Engineering standards have been modified to fit the road system into the confined space as a result of not landfilling in the lake. These include the provision of a steeper ramp for exit from the freeway and placement of a merging lane on the bridge over Powis Street, rather than before the bridge on the fill. The radii of curves has also been reduced to accommodate the total road formation, thus resulting in sharper curves in the roadway. This overall change does result in increased construction time.

The aesthetic impact of this alternative on views of the lake foreshore is the most significant of all the alternatives. To restrict the roadworks and associated facilities to the area outside the waterbody of the lake requires the construction of a four (4) metre high retaining wall to contain the freeway embankment where it is closest to the lake and stone pitched batters for some distance beyond each end of the retaining wall to a point where vegetated batters can be developed. Safety barriers would be placed on top of the retaining wall, as shown at Figure 8. The subsequent proximity of the traffic to users of the dual use path would reduce the value of this area for recreation purposes, compared to present values. This would be exacerbated by the limited width of foreshore provided.

The restricted foreshore width would not favour the use of the area by wildlife as the cover presently available would be disturbed in the construction of the dual use path and the movement of people in the process of moving through this section would not encourage its use by fauna for purposes other than those which provide interactions with people, such as hand feeding. The ability of such a thin strip of vegetation to persist in the long term is doubtful due to the pressure from both fauna and lake users. This is evident in other sections of the lake where there are high levels of usage associated with poor vegetation cover.

The presence of the wall would also shadow the lake shore from the easterly wind and this may result in an accumulation of debris in this area following period of strong westerly wind. Consequently the adoption of this alternative would require a commitment to periodically carry out a clean up of the shoreline to remove accumulated debris.

The additional cost associated with this alternative totals $1 million, mostly as a result of the additional costs of the retaining wall.

6.4.4 Alternative 4

This alternative retains similar road geometry to Alternative 3, that is it requires some changes to the southbound carriageway and reduced radii of for the curves. It is constructed to allow the freeway to pass under Powis Street, rather than over it as it does now. As mentioned in Alternative 3, it requires no filling of the lake.

To accommodate this change requires the demolition of the existing bridge carrying the freeway over Powis Street and its replacement with a bridge to carry Powis Street over the freeway and accompanying rail system.

This alternative has improved aesthetic appeal as it removes the necessity for a high retaining wall adjacent to the lae foreshore. However it still requires placement of the dual use path close to the existing lake edge as in Alternative 3. Impacts of this alternative with respect to the lake edge are consistent with those in Alternative 3. However those impacts which result from the shadow effect of the retaining wall are not applicable.

Costs associated with this alternative are estimated to be in the order of $4 million above Alternative 1, mainly as a result of the reconstruction of 2.5 kilometres of the existing freeway, and associated additional earthworks required for the modification of the Powis Street alignment. In addition substantial time is required to construct this alternative and the construction process would result in a major disruption to existing freeway traffic. However construction could still be completed to allow the completion of the Northern Suburbs Rail system by the target date in late 1992.

6.4.5 Alternative 5

This alternative considers the total realignment of the freeway to the east, on the opposite side to the lake. Its most obvious benefit is the maintenance of existing conditions in respect to Lake Monger and its surrounding foreshore areas.

However this alternative requires the resumption and demolition of a substantial number of residential properties, at least 25 in number, plus relocation of a church and acquisition of part of the grounds of a private school. The cost of property resumption is estimated to add at least an additional $7 million to the cost of the project. To construct the freeway would then require the construction of an additional 3 bridges at the Powis Street interchange and realignment and reconstruction of some 2.5 kilometres of freeway pavement. The total cost of this alternative may exceed the cost of Alternative 1 by $20 million.

The final product would not have the same standard of road alignment as the rest of the freeway network. The interchange at Powis Street would be constrained due to the confined space to construct the interchange thus not allowing reasonable distance intervals between intersections within the interchange.

This alternative cannot be constructed with the timeframe necessary to complete the Northern Suburbs Rail system by late 1992.

6.4.6 Alternative 6

This alternative has been developed to allow construction of the freeway widening with minimal modification of the southbound carriageway and retention of the existing lake edge. The provision of the necessary space required is the result of reducing the space taken up by the railway and its buffer with the road system.

The result is similar to Alternative 3 with a reduced height in the retaining wall and placement of the dual use path on a boardwalk placed over the water surface. The retaining wall would comprise a 3.5 metre high gabion wall (or a crib block wall) with guardrailing on the top.

The restricted foreshore width would not favour the use of the area by wildlife as the cover presently available would be disturbed in the construction of the dual use path and the movement of people through this section would not encourage its use by fauna for purposes other than those which provide interactions with people, such as hand feeding. The ability of such a thin strip of vegetation to persist in the long term is doubtful due to the pressure

from both fauna and lake users. This is evident in other sections of the lake where there are high levels of usage associated with poor vegetation cover.

Unlike other Alternatives 2 to 5, this alternative does not provide for the opportunity to improve the foreshore as described in Alternative 1, if it was desirable to do so in the future, without considerable disruption to users of the dual use path.

This alternative has a number of other disadvantages which relate to the traffic safety and railway maintenance. To provide the lesser height of retaining wall at the lake edge the space occupied by the rail system has been reduced to an absolute minimum. This requires the separation of road and rail traffic by a concrete guardrail structure which has poor overall aesthetics and detracts from the driving environment of the road when used for long intervals such as the 2.5 kilometres required in this instance. Further the space allowed to maintain the rail structure in this section does not provide for motor vehicle access to the rail system and would require all maintenance operations to be carried out on foot in this section of 2.5 kilometres length. The nature of the maintenance processes involved and the provision of safe refuge for rail maintenance staff makes the practicality of this option questionable.

The additional works associated with this alternative are estimated to cost some $750 000 more than Alternative 1 for construction with significant additional costs in the maintenance of the rail system.

7 ENVIRONMENTAL COMMITMENTS

The following commitments can be made in relation to the Main Roads Department's preferred alternative (Alternative 1). These commitments can be wholly or partially applied to most of the other alternatives if the preferred alternative is not considered acceptable by the public review of the proposal.

7.1 Temporary Visual Impact

Surcharging will not exceed a height of up to 4.5 metres above the existing freeway level. This will create a temporary visual impact for 12 months from mid 1990 to mid 1991.

7.2 Sand Fill Transport

Trucks hauling surcharge material over public roads will be fitted with tight tailgates and loaded with adequate freeboard of not less than 75 mm without precarious cones or piles of material. Covers will also be used on all material transported.

7.3 Dust Control for Surcharge Sites

Surcharge sites will be watered as required during construction. At the conclusion of the surcharge period, these areas will be hydromulched.

7.4 Protection of Wildlife, Particularly Tortoises

The following proposed sequence of events will ensure minimal dislocation to the wildlife habitat at the eastern boundary of Lake Monger and will result in increased protection for breeding tortoises.

- installation of mesh fence in lake 5 - 10 metres offset from proposed new lake edge alignment.
- translocation of tortoises and other aquatic life to other side of this fence.
- creation of an island approximately 50 x 20 metres at water level.
- creation of new lake edge.
- removal and temporary storage (if necessary) of reeds for translocation to new shoreline and island edge.

7.5 Protection of Lake Monger Reserve Recreational Values

Pedestrian and cyclist access to the dual use path which circumnavigates the lake will be maintained during the landfill period by the following proposed sequence of events.

- creation of new lake edge
- completion of earthworks between existing dual use path and new shoreline.
- installation of new path on final alignment

- installation of new boundary fence on final boundary
- .installation of surcharge for ramps and carriageway.

Detailed design and sectional sketches of the treatment of the lake foreshore are included at Figures 12, 13 and 14.

7.6 Consolidation Leachate Entering Lake Monger

Consultant tests (Golder Associates, 1985) of water quality of the landfill, peat and lake indicate similar water qualities from all test sites with the conclusion that the amount of water dislodged by consolidation will not significantly affect water quality in Lake Monger.

To ensure the findings of the consultant are consistent with water qualities present at the time of surcharging the Main Roads Department will establish monitoring boreholes to assess water displacement from under the surcharged areas, and the quality of water which enters Lake Monger.

7.7 Stormwater Management

Stormwater drainage of the freeway pavement will be subject to detailed design currently underway for the new carriageway. This design investigation will include an assessment of the contribution freeway runoff contributes to the poor water quality in lake Monger.

Cutoff drains may be required to prevent silt discharging into the lake during surcharging. The Main Roads Department will install and monitor regularly this requirement in close liaison with the Water Authority of Western Australia.

7.8 Liaison With Aboriginal People

Lake Monger is recorded as an area of Aboriginal significance. The Main Roads Department will conduct on site discussions with the Aboriginal people with an interest in the area to allow the expression and documentation of their opinions. A report will then be submitted to the Aboriginal Cultural Materials Committee as requested when the Main Roads Department applied to disturb the recorded Aboriginal Site at Lake Monger. The discussion and report will be prepared in parallel with public comment on this Public Environmental Review.

The Main Roads Department will also conduct an investigation of the archeological status of the area with respect to the presence of artifacts derived from use of the area by Aboriginal people.

8 CONCLUSION

The widening of the Mitchell Freeway between Loftus and Hutton Streets is in accordance with original plans for construction of two separate carriageways. Construction of the northbound carriageway on the section adjacent to Lake Monger will facilitate the location of the Northern Suburbs Railway in the median of the freeway between Perth and Joondalup.

The State Government's commitment to operation of the rail system by 1992 requires surcharging of the existing freeway reserve and reclamation of a small portion of the north eastern quadrant of Lake Monger in preparation for road construction. Environmental impacts of this proposal for preparatory work in the vicinity of Lake Monger have been carefully evaluated to retain the significant recreational and wildlife values of the lake foreshore while substantially benefiting the public and meeting the commitment of Government in the introduction of the rail system.

The proposals as detailed in this report entail no significant environmental impact. While a temporary visual impact during the surcharging phase is acknowledged for a period of up to 12 months, it is considered that important long term benefits for the road and rail traveller, for local residents and other users of Lake Monger Reserve, and for the tortoise population and other wildlife of the area warrant the construction of the preferred option (Alternative 1) described which includes enhancement of the lake foreshore and its amenity through alteration of the landscape in a section of the north east quadrant of Lake Monger.

9 REFERENCES

1. Golder Associates Pty Ltd, 1985, First Stage Report Geotechnical Investigation for Main Roads Department.

2. G C Cocks, Materials Engineering Branch MRD, 1989, Northern Suburbs Railway Preliminary Geotechnical Appraisals, Materials Report No 89/41M.

3. Porter, Dr Barbara; Dunlop, Dr J N and Clay Brian, 1986, Mitchell Freeway Stage III Fauna Survey and Tortoise Study Informal Interim Report and (1987) Fauna Survey and Tortoise Survey (unpublished).

4. Main Roads Department, 1989, Environmental Management Manual (Draft).

5. Blackwell & Associates Pty Ltd, 1987, Landscape Works Mitchell Freeway Stage III, Powis Street Ramp - Adjacent to Lake Monger, for Main Roads Department.

6. City of Perth, 1989, Development and Management Concept Plan for the Lake Monger Reserve.

7. Davis J, and Humphries R, 1989; Wetland Function in Wetlands in Crisis - What can local government do?, Conference Papers, 15 June 1988; Environmental Protection Authority Bulletin 372, Perth Western Australia.

8. Middle G.J., 1988; A Method To Evaluate Conservational and Social value of Lenthic Wetlands on the Swan Coastal Plain; A Thesis Presented for an Honours Degree, Environmental Science, Murdoch University, Murdoch Western Australia.

9. Brown S.H., 1983; A Survey For Aboriginal Sites - Ethnographic investigations relating to some proposed highway and road developments in the Perth metropolitan area; unpublished report to Main Roads Department.

10. O'Connor R., Bodney C. and Little L., 1985; Preliminary Report on the Survey of Areas of Significance in the Perth metropolitan and Murray River Regions. Unpublished.

THE ABOVE DOCUMENTATION CAN BE VIEWED AT THE MAIN ROADS DEPARTMENT (4TH FLOOR), WATERLOO CRESCENT, EAST PERTH, WA 6004

.

LANDFILL FOR THE FUTURE WIDENING OF THE MITCHELL FREEWAY AT LAKE MONGER - EPA GUIDELINES FOR THE PREPARATION OF A PUBLIC ENVIRONMENTAL REVIEW (PER)

The purpose of this document is to outline the content required in a PER for preloading and filling operations on the north eastern edge of Lake Monger to enable environmental assessment.

1 SUMMARY

This section should contain a brief, concise overview of the proposal including project description, site location and identification of the key environmental issues and conclusions.

2. INTRODUCTION

This section should include the following:

- background of the proposal
- objectives of the proposal
- purpose of the document (PER) with regard to environmental review.
- timing of the proposal (with regard to being brought forward due to the Rapid Transit System).

3. NEED FOR THE PROPOSAL

This section enables the proponent to discuss the need for the proposal.

4. PROJECT DESCRIPTION

This section should cover all facets of the surcharging operation and rehabilitation of the surrounding areas. The description should be thorough and would include the following:

- timing and description of stages in the proposal.
- sources and transport of construction material.
- details of construction methods to be employed including earthwork and plant description.

Environmental controls such as minimising dust and noise from construction should also be incorporated in the process description. Details of rehabilitation plans as a separate issue or a component of a larger facet should also be addressed in this section.

6. Existing Environment

This section should be a thorough report on investigations into the project area. Included should be all components of the environment that will be affected by the proposal in any way. This should include inter alia:

- biological significance of the area with regard to existing flora and fauna.
- current human use patterns for the area.
- historical/anthropological significance of the area.
- previous landfill sites and their significance.
- visual catchments and landscape quality.
- ground/surface water information and drainage patterns.
- current management issues.

7. Environmental Impacts and Management

This section deals with the identification of impacts and their management. Environmental impacts may occur on any section of the environment including surface and ground water bodies, flora and fauna, human use and landforms. Impact identification at this stage will result in improved implementation of management programmes. Impact prediction should be as comprehensive as possible.

The following list is an indication of some possible impacts but is not comprehensive.

Construction Phase

- dust, noise, visual impact
- anthropological or ethnographic sites
- disruption of human use patterns
- storage and servicing of construction vehicles
- leachate from old landfill site
- impacts on lake through filling and construction activities (physical impact on lake and disruption of wildlife).

Operational Phase

- visual impact
- impact on recreational users of lake and surrounds
- long term impacts on the lake and surrounds
- long term impacts on the lake and surrounds (eg management of drainage waters, groundwater impacts).

After the environmental impacts have been identified, integrated management programmes and techniques need to be developed to minimise or negate these. To be effective, the management of environmental impacts should be an integral, well planned part of the project as a whole. Management should include monitoring of impacts in the construction and operational stages and remedial action that may be required. Management obligations in the long term should also be discussed.

8. Conclusion

The conclusion should contain an overall statement of the impacts identified and their management.

Extract from Reference No 2

G C Cocks, Materials Engineering Branch MRD, 1989, Northern Suburbs Railway Preliminary Geotechnical Appraisals, Materials Report

No 89/41M.

APPENDIX A

DESCRIPTIVE SUMMARY FOR FOUNDATION IMPROVEMENTS OPTIONS

STONE COLUMNS

Stone columns work by supporting the road/rail embankment and reducing overall settlement. They are technically feasible in areas of peat and shallow sanitary landfill. However, their effectiveness is doubtful when the length/radius ratio exceeds about 12. For 1 metre diameter columns, this limits the application to areas with less than 6 metres of soft soil. They can be used in combination with surcharge.

In sanitary landfill, problems of driving through or past concrete and tree stumps may be a problem. This will limit their application to areas with less than 2 metres of landfill.

DYNAMIC COMPACTION

Dynamic compaction involves dropping a large mass (say 14 tonne) from a large height (say 10 metres). It is effective in reducing differential settlement in sanitary landfill. Overall average settlement is deferred but not significantly reduced. It may be used in conjunction with surcharge preloading to control average settlement.

Dynamic compaction is probably ineffective on peat.

Surcharge Preloading

Surcharge preloading involves placing an additional load on the soft soil for a long period (say 1 year) to accelerate the settlement so it is substantially complete before final structures (pavements or rail track) are constructed. It is effective on peat and sanitary landfill.

Excavation

Soft soil (peat and sanitary landfill) can be excavated and replaced with clean sand. This is an effective treatment which largely eliminates post construction settlement problems. However, it becomes expensive when peat depth exceeds about 0.5 metres. In sanitary landfill, it is every expensive and generally avoided for aesthetic and health reasons. Disposal of partially decomposed waste can be a problem.

Geotextiles

A layer of strong geotextile placed on the subgrade can be used to reduce pavement cracking over a weak subgrade in areas where this is critical. Cracking needs to be controlled in car parts and similar areas where there are pedestrians.

Geotextiles are ineffective in reducing settlement but may be used in combination with other techniques such as dynamic compaction and surcharge preloading.

Post Construction Settlement

Except for excavation and replacement, some post construction settlement occurs over peat and sanitary landfill regardless of which treatment is used. For freeway pavements, the foundation improvement design is usually based on an average post construction settlement of 75 mm or 100 mm for a 30 year design life.

APPENDIX B

SUMMARY OF BORE HOLE RESULTS TO TEST GROUNDWATER QUALITY

Extract from Reference No 1

Golder Associates Pty Ltd, 1985, First Stage Geotechnical Investigation for Main Roads Department

SUMMARY OF BORE HOLE RESULTS TO TEST WATER QUALITY

Introduction

Chemical Analyses were performed on three water samples by Analabs Pty Ltd. Samples analysed were:

- BH1/85, Sample 3, from peat stratum
- BH2/85, Sample 2, from landfill stratum
- Lake Monger, Sample 5

The results of the analysesare summarised on Table B1. An overview of the results indicate that all samples meet recommended standards for drinking water. The fact that all samples are of similar quality suggests that the proposed freeway widening will have little influence on the quality of water in Lake Monger.

Comparison of Samples from BH1/85 and BH2/85

The water analysed from BH2/85 was sampled while casing was still in the landfill and was therefore considered to be representative of groundwater in the landfill. The water analysed for BH1/85 was sampled for slotted casing sealed into the peat and was therefore considered to be representative of groundwater from the peat.

The sample from the peat (BH1/85) had a higher pH, Pb and Cu concentration than the sample from the landfill (BH2/85) and a lower HCO_3, Ca and SO_4 concentration.

In the sample from the landfill, bicarbonate levels are higher and SO_4 levels are considerably higher (25 times than that of the sample from the peat.

The Pb and Zn levels in both samples are, as expected, low. However, the sample from the peat has slightly higher levels of Pb and Cu than does the sample from the landfill. The higher levels of SO in the landfill sample would precipitate any soluble lead, whilst the dissolved iron as Fe would cause an increased solubility of Cu and Zn than would normally be achieved. In the landfill sample, the greater amounts of phenols and a possible greater origin of Zn create zinc organic complexes which maintain Zn in solution. However, it should be noted that these Zn levels are two orders of magnitude below the drinking water standards.

The results confirm that the sample from BH2/85 is influenced by weathering processes within the sanitary landfill whilst the sample from BH1/85 IS NOT.

Comparison of Water Quality of Lake Monger with the Water Quality of the Bores

The lake water has slightly higher electrical conductivity, Na, C1, NO_3, P, but lower pH than the bore samples. The concentration of SO_4 in the lake is higher than the BH1/85 sample but lower than the BH2/85 sample.

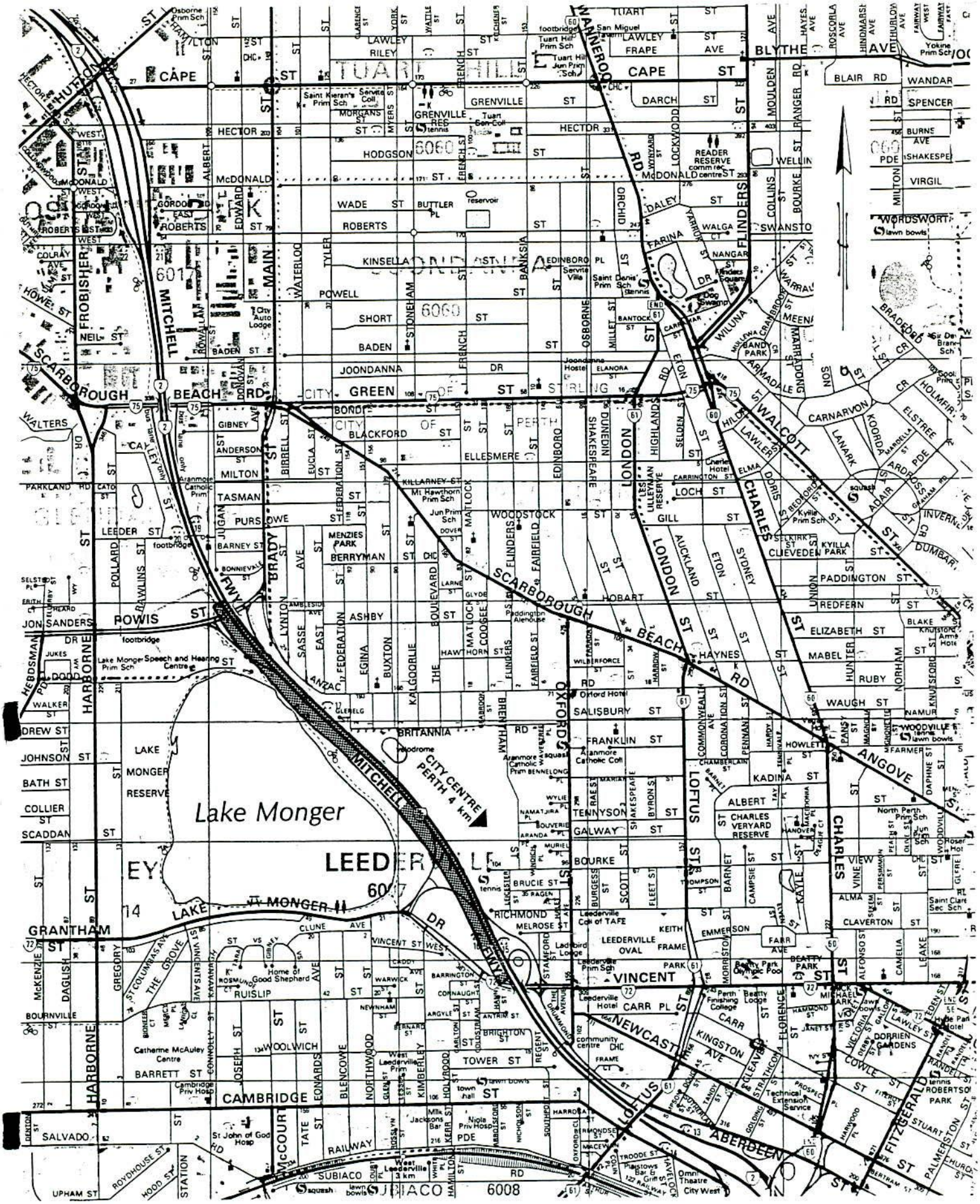
Electrical conductivity and summed ions are in indirect measurement of TDS. Therefore, the TDS of the lake is greater and on this basis the quality of the lake is worse than the water in the bore. If the BH2/85 sample reflects the worst groundwater input from the sanitary landfill into the lake then the main contaminants of the lake must be either due to surface runoff or another more contaminated source.

The introduction of agricultural development to an area causes a define in water quality in that area. Clearing of the land caused increased runoff and raised water tables which result in a higher level of NaCl. Higher NO_3 and PO_4 levels are probably influenced by fertiliser application to the large areas of lawn around the lake.

TABLE B1

WATER QUALITY TEST RESULTS

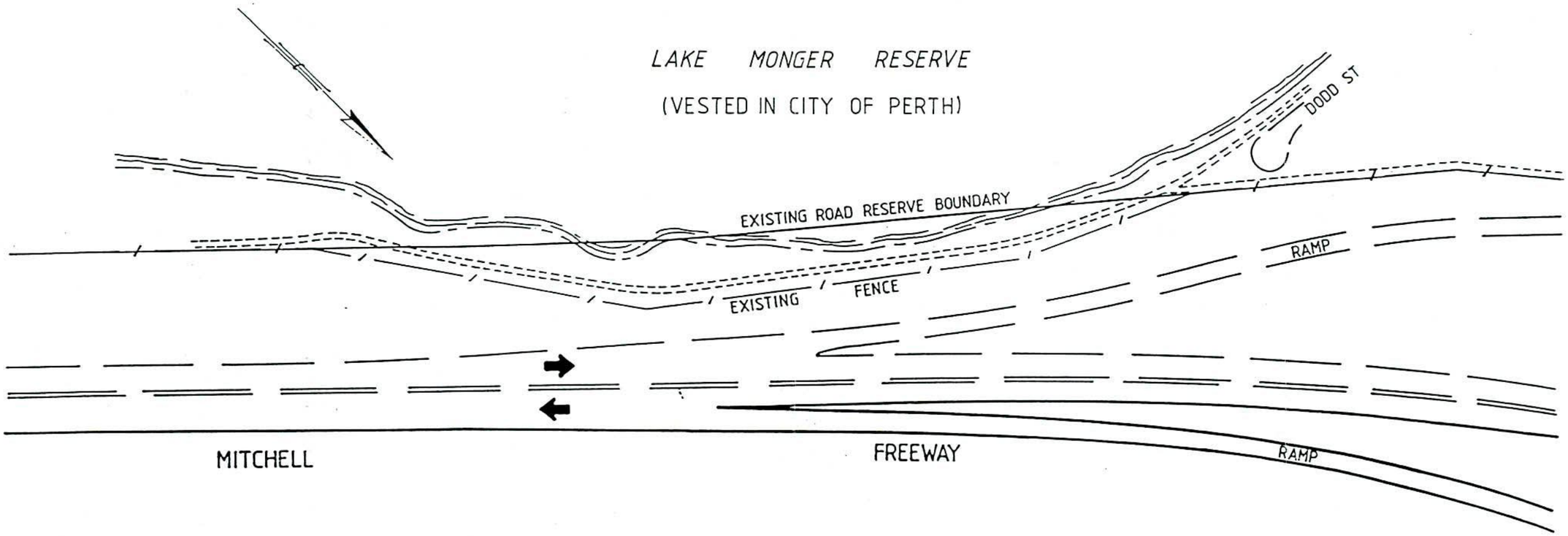
		BH1/85 (Garbage) Sample 3 Peat	BH2/85 (Sand Fill) Sample 2 Landfill	LAKE MONGER
pH		7.97	7.51	7.35
Conductivity (siemens/cm)		665	762	803
Resistivity (ohms/m)		15.04	13.12	12.45
TDS (Calc)		425.6	487.7	513.9
Sodium (Na^+)	mg/1	82	77	97
Potassium (K+)	mg/1	10.5	5	10.5
Calcium (Ca^{++})	mg/1	16.5	71	34
Magnesium (Mg^{++})	mg/1	4.5	10.5	16.5
Soluble Iron	mg/1	0.15	<0.05	0.05
Chloride (Cl^-)	mg/1	133.5	132.1	160.5
Carbonate (CO_3^{--})	mg/1	<0.3	<0.3	<0.3
Bi-carbonate (HCO_3^-)	mg/1	128.1	189.1	137.3
Sulphate (SO_4--)	mg/1	2	50	25
Nitrate (NO_3)	mg/1	0.2599	0.1239	0.5433
Total Nitrogen (N)	mg/1	-	0.05	0.3
Total Phosphorous (P)	mg/1	-	<0.05	0.4
Phenols	mg/1	-	0.145	0.074
Tin (Su)	mg/1	<0.05	<0.05	<0.05
Zinc (Zn)	mg/1	0.037	0.046	<0.001
Lead (Pb)	mg/1	0.007	<0.005	<0.005
Copper (Cu)	mg/1	0.012		0.015
Sum of Ions	mg/1	387.3	534.8	481.3



SITE PLAN

SCALE 1:20000

FIGURE 1



EXISTING LAND TENURE

FIGURE 2

STREET

VINCENT

LAKE

MONGER

DODD ST

STREET

LEEDER ST

CAYLEY

STREET

POWIS

JUGAN

STREET

MATCH CHA

LINE 6500

LINE 5200

LINE 5100

IVL3
3ALI
3ARI
3NLI
℄ MN03
3NRI
INR1
RV01
RV02
INR2
INR3
RV03
RV04
INR4
INR5
RV05
IPL3
33LI
RV06
INR6
3NLI
IPL4
40LI
30RI
4NLI
4NRI
INR7
RV07
INR8
RV08
IPL1
3IRI
3ILI
IPR1

LEGEND:

EXISTING LAKE MONGER EDGE

EXISTING ROADS & BRIDGES

EXISTING FENCES

NOTES:

1. USE COMPUTER PRINTOUT TO SET OUT ℄ MN03
2. TO BE READ IN CONJUNCTION WITH CROSS SECTIONS DRG No's 8931-

SURCHARGE AREA

FIGURE 3

TOTAL AREA TO BE SURCHARGED FOR ROADWORKS

MICROFILMED DATE	SCALES QUOTED APPLY TO ORIGINAL DRAWING SCALE
SURVEYORS AND DATE	SURVEY BOOKS
DATUM A.H.D.	

IN THE ABSENCE OF THE APPROVED SIGNATURE THIS DRAWING SHALL BE TREATED AS PRELIMINARY

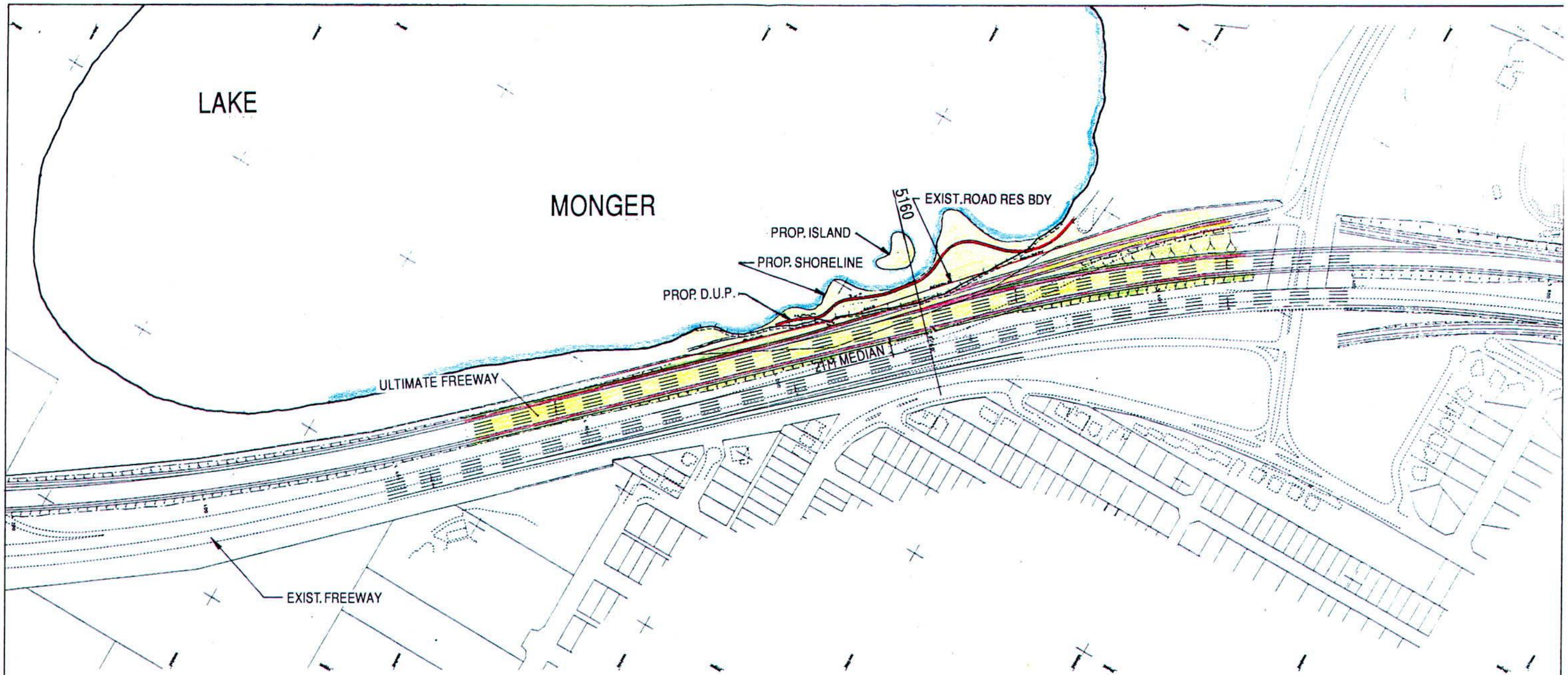
	NAMES PRINTED IN FULL	DATE	SIGNATURES	DATE
DESIGNED	R. de VENETZ/S ASHWORTH	SEPT '96	AUTHORIZED	
DRAWN	MOSS/C PARK	SEPT. '96	RECOMMENDED	
CHECKED			APPROVED	
QUANTITIES				

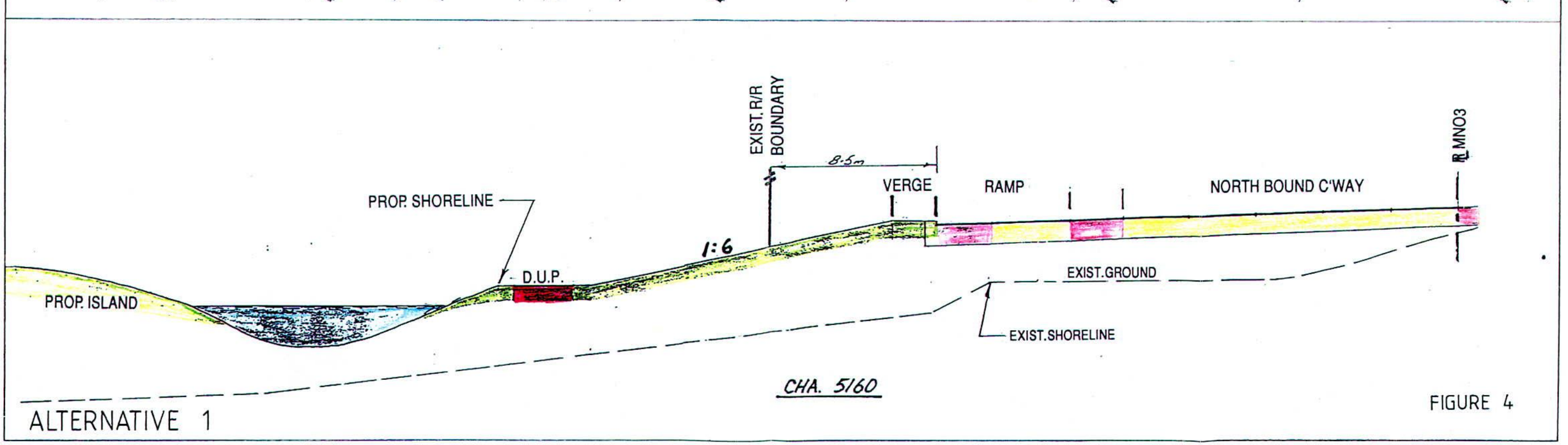
MITCHELL FREEWAY H16
STAGE3 (3.48 SLK TO 5.52 SLK)
VINCENT ST (55) TO POWIS ST (62)
SURCHARGE PLAN
CHA. 3740 TO CHA. 5700 & MN03
LOCAL AUTHORITY CITY OF PERTH (126) CITY OF STIRLING (125)

MAIN ROADS DEPARTMENT W.A.
URBAN ROAD DESIGN

FILE NUMBER	DRAWING TYPE	DRAWING NUMBER	AMEND.
	00:10	8931-	

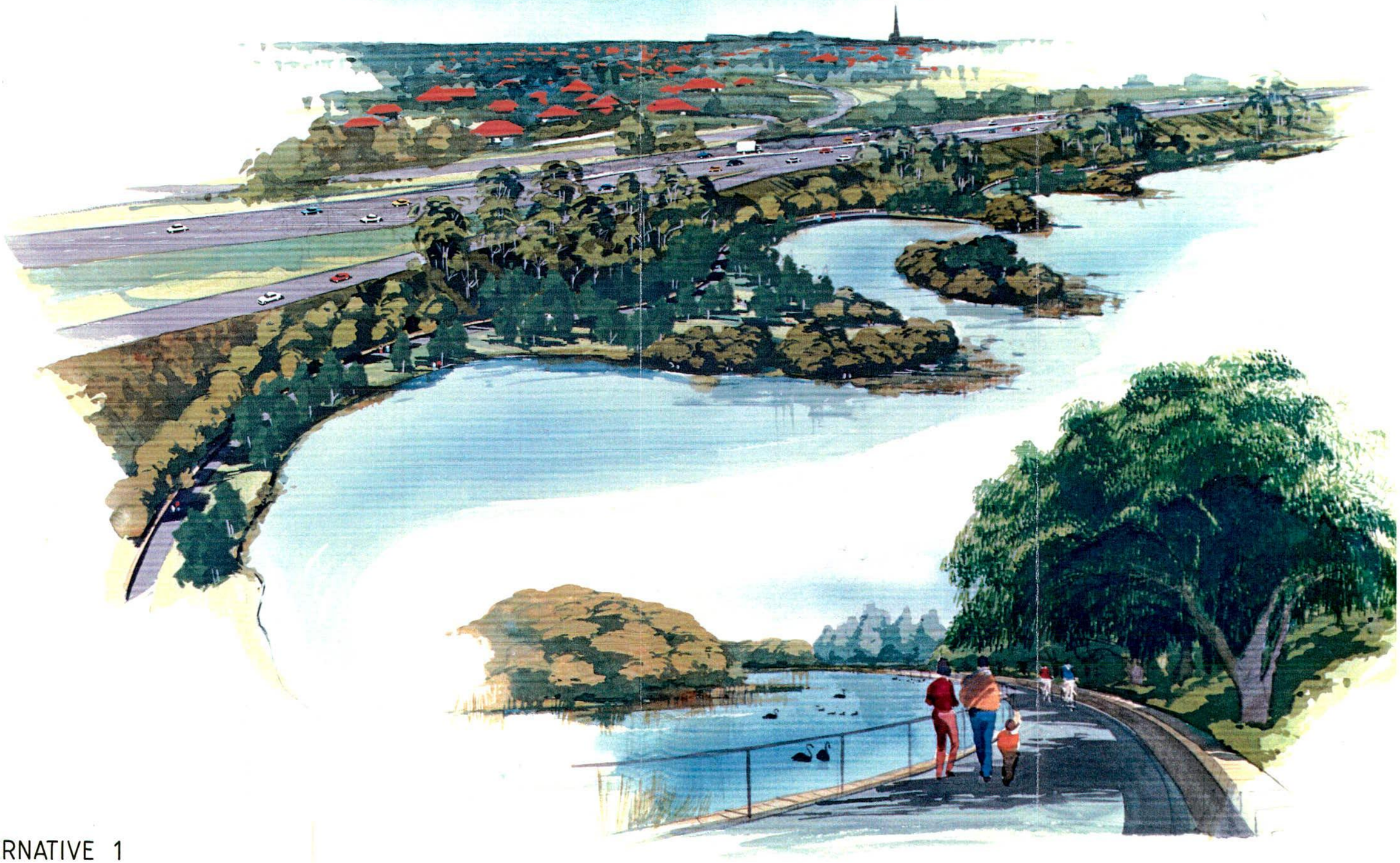
SCALE
HORIZONTAL 1:1000 VERTICAL 1:1000





ALTERNATIVE 1

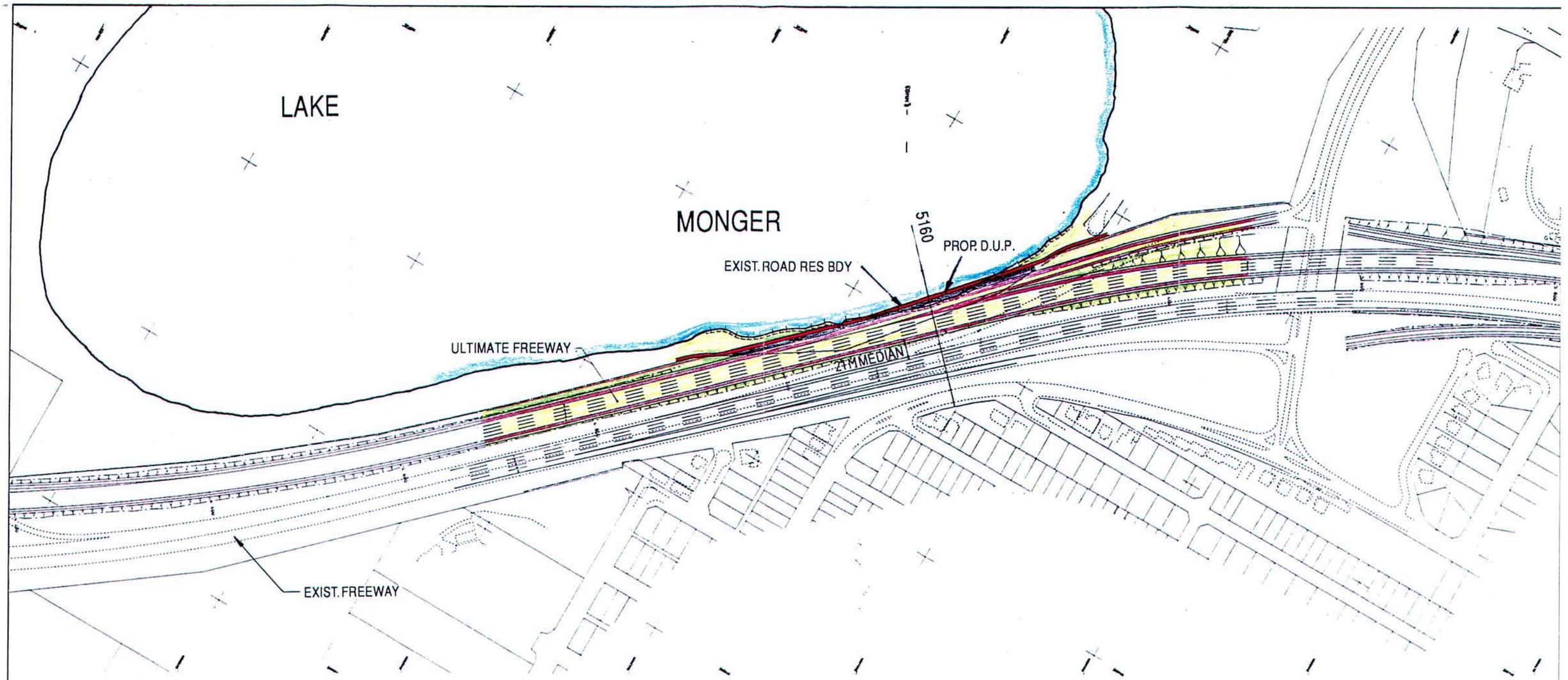
FIGURE 4

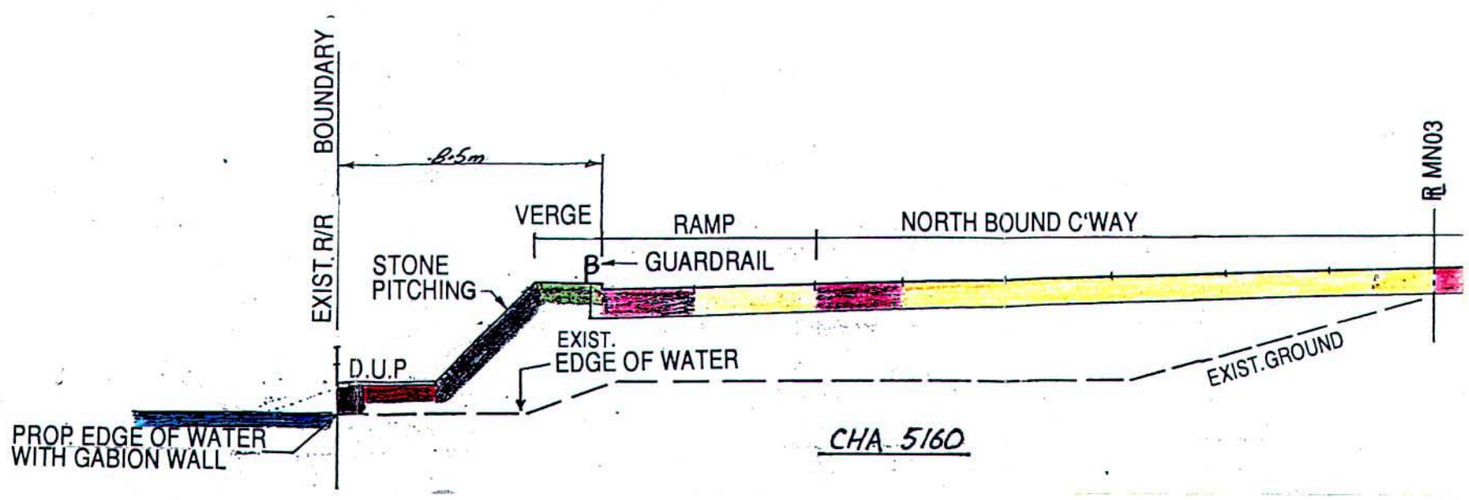


ALTERNATIVE 1

PROPOSED LANDSCAPE TREATMENT

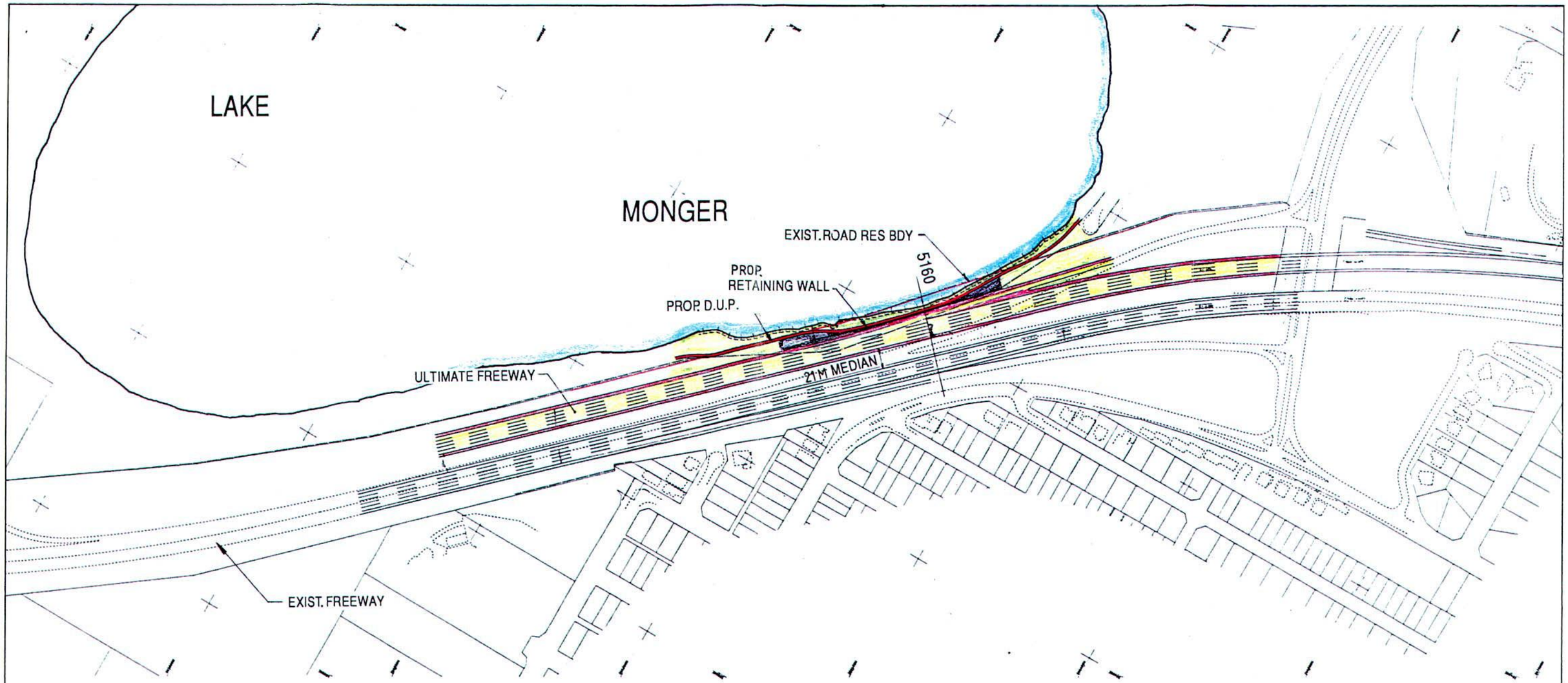
FIGURE 5

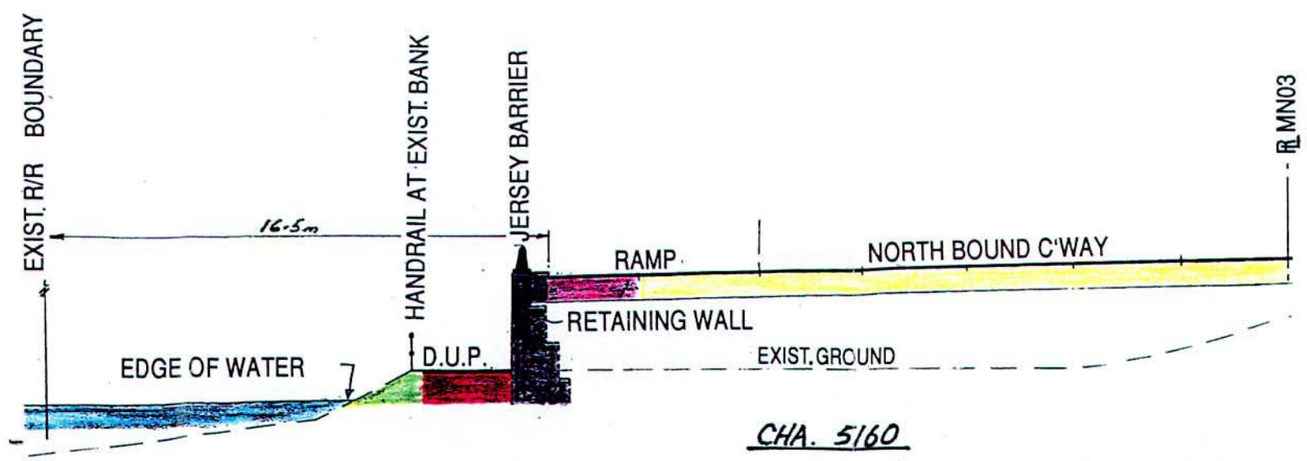




ALTERNATIVE 2

FIGURE 6



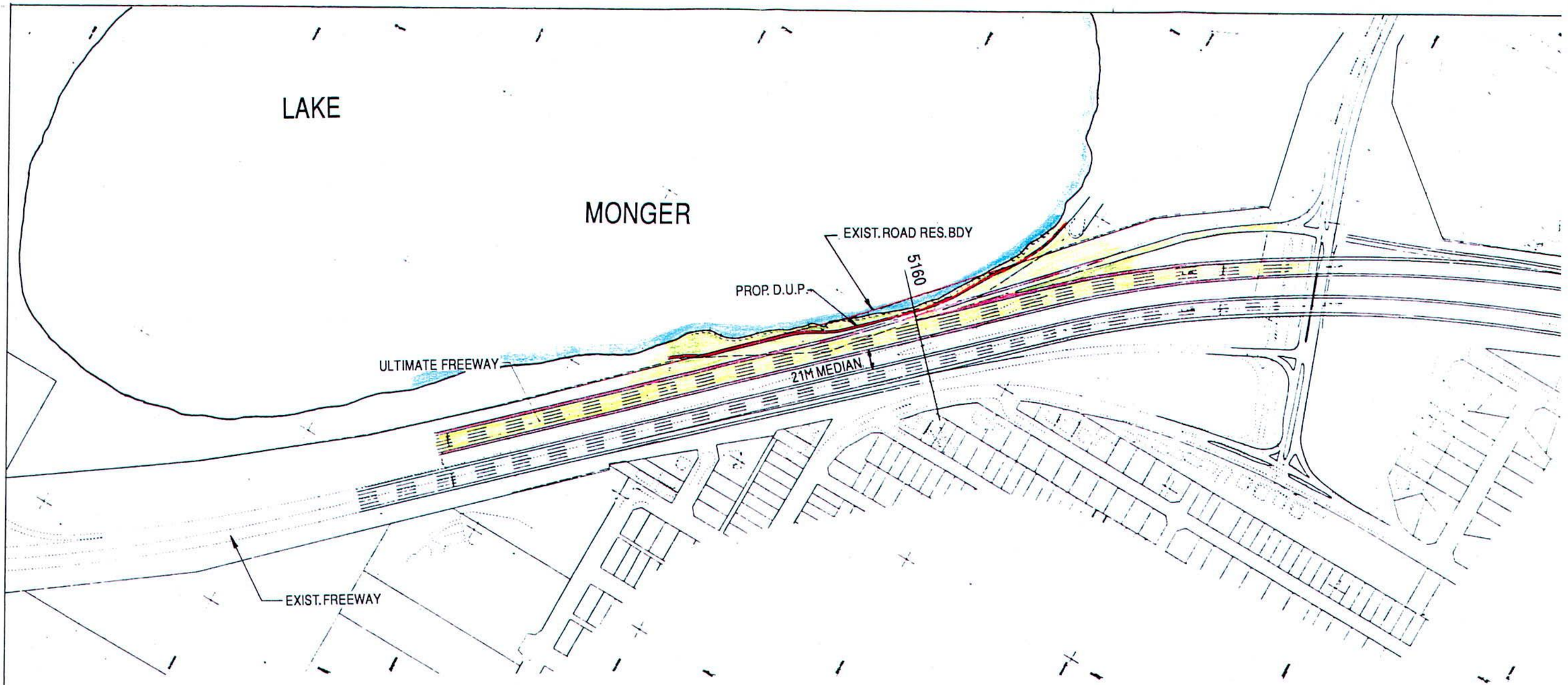


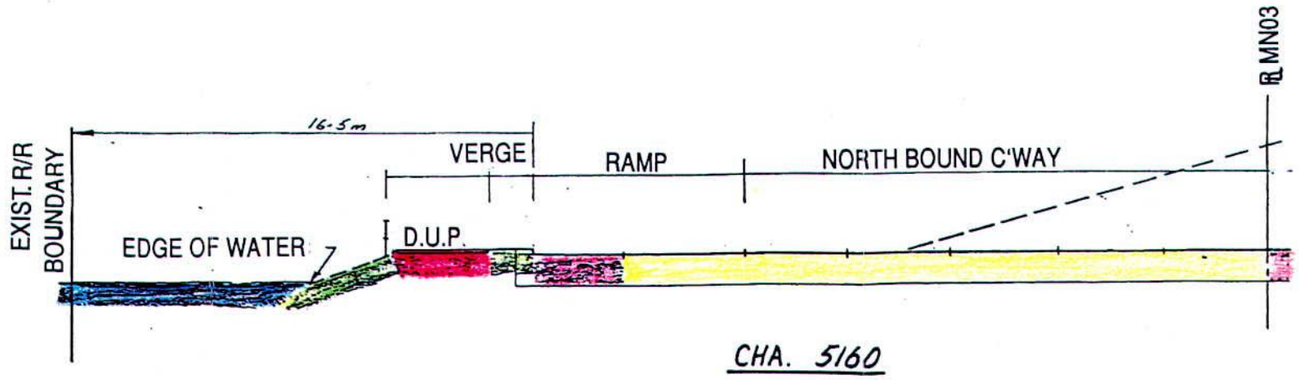
ALTERNATIVE 3

FIGURE 7

ALTERNATIVE 3
PROPOSED LANDSCAPE TREATMENT

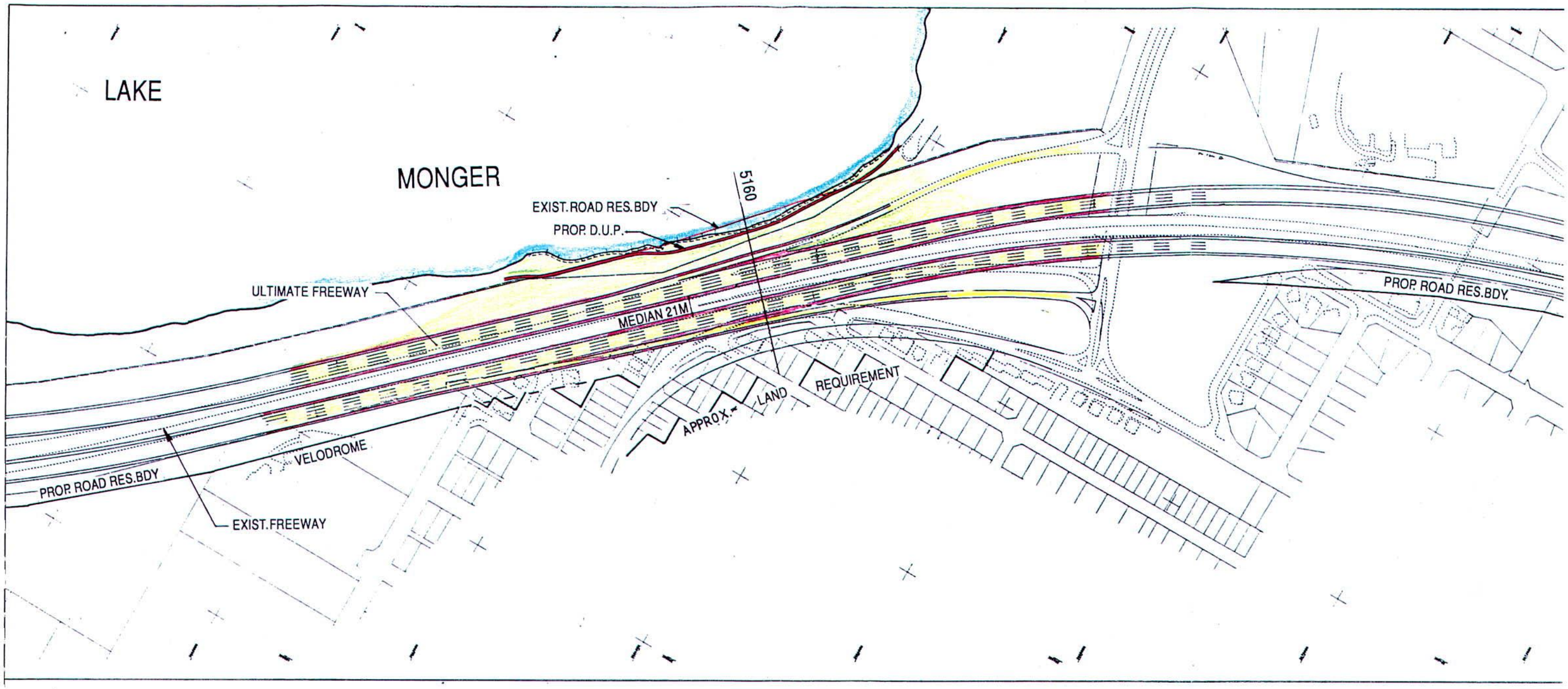
FIGURE 8

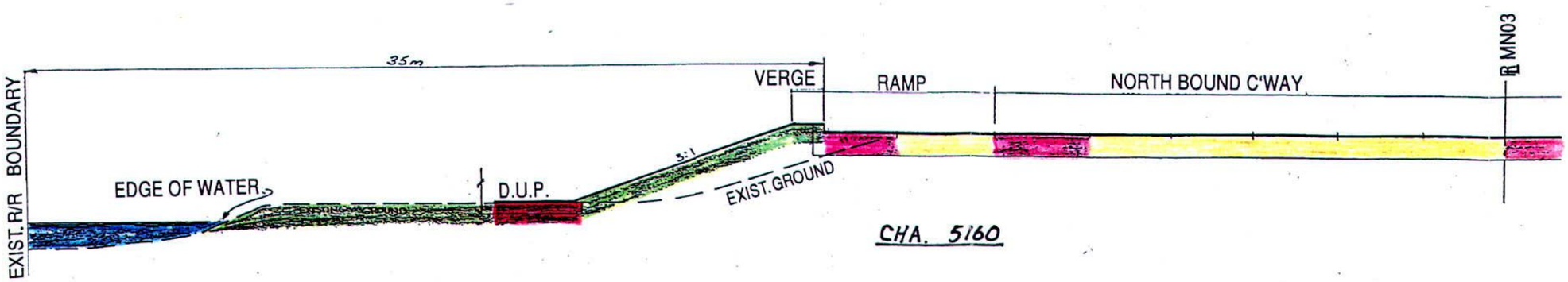




ALTERNATIVE 4

FIGURE 9





ALTERNATIVE 5

FIGURE 10

LAKE

MONGER

PROP. D.U.P.

5160

EXIST. ROAD RES. BDY.

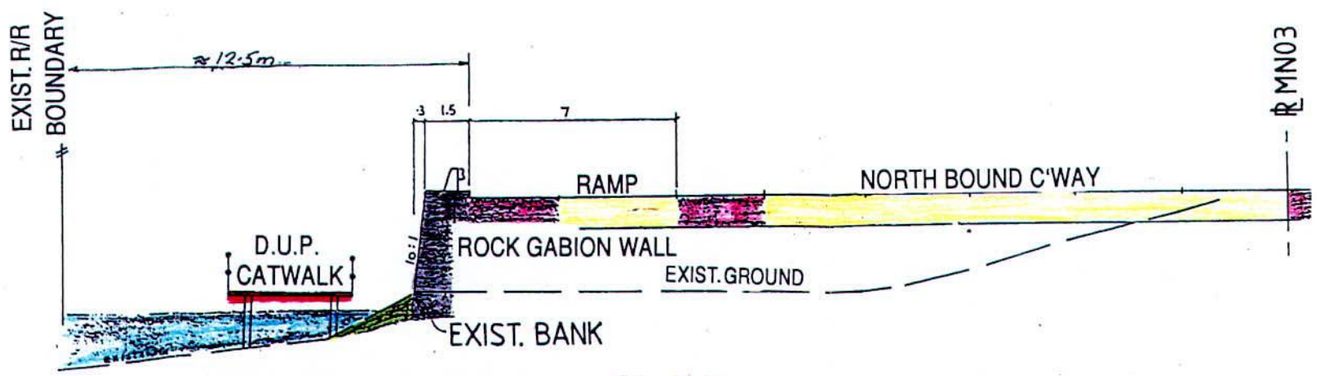
PROP. GABION WALL

ABS. MIN. TO MAINTAIN RAILWAY STANDARDS

ULTIMATE FREEWAY

MEDIAN 18.6M

EXIST. FREEWAY



CHA 5160

ALTERNATIVE 6

FIGURE 11

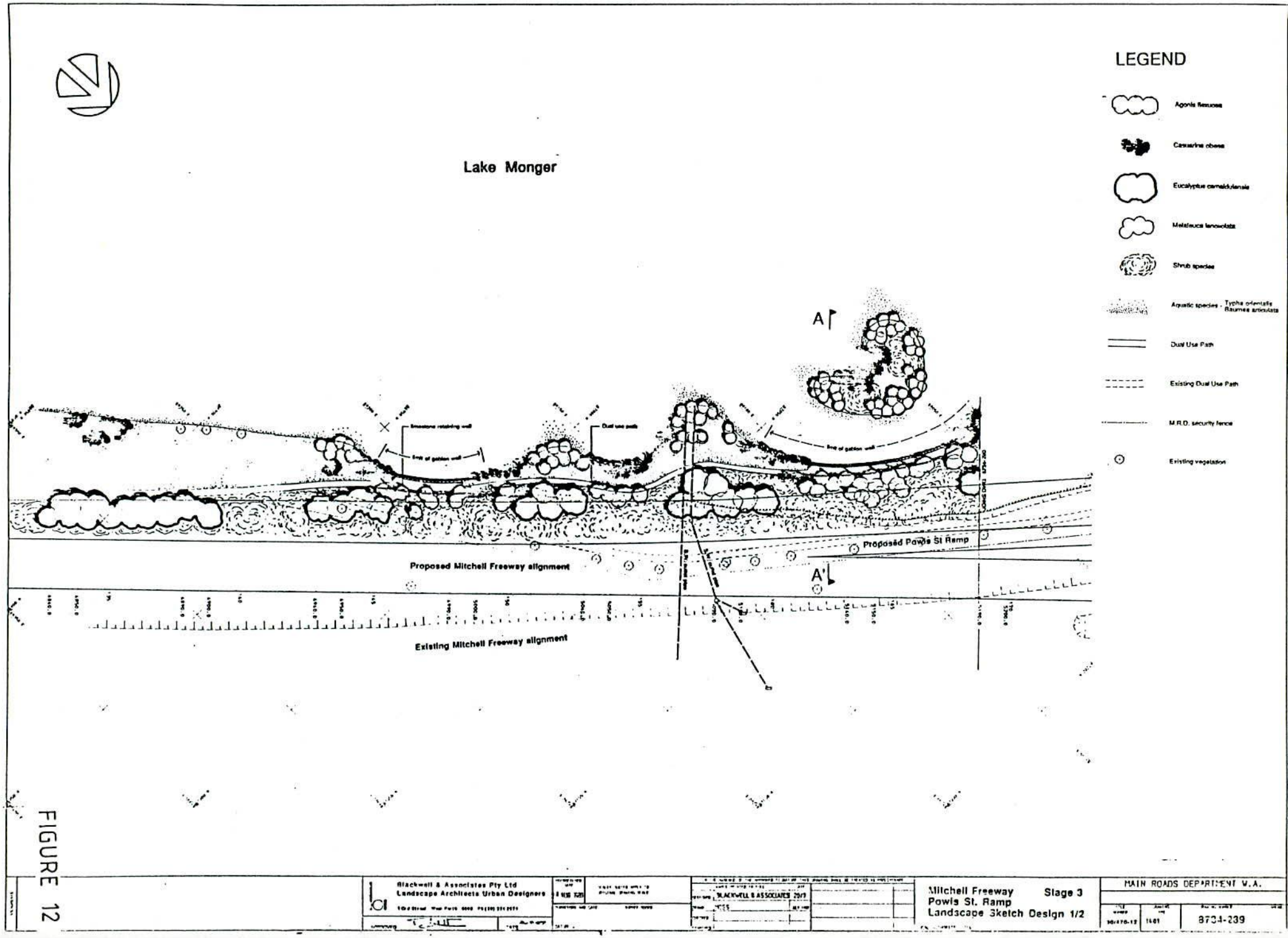

Lake Monger
LEGEND
Agonis flexuosa
Casuarina obesa
Eucalyptus camaldulensis
Melaleuca lanceolata
Shrub species
Aquatic species - Typha orientalis Baumea articulata
Dual Use Path
Existing Dual Use Path
M.R.D. security fence
Existing vegetation
A
A'
Limestone retaining wall
Limit of gabion wall
Dual use path
Proposed Powis St Ramp
Proposed Mitchell Freeway alignment
Existing Mitchell Freeway alignment
Blackwell & Associates Pty Ltd
Landscape Architects Urban Designers
BLACKWELL & ASSOCIATES 29/3
Mitchell Freeway Stage 3
Powis St. Ramp
Landscape Sketch Design 1/2
MAIN ROADS DEPARTMENT W.A.
8734-239

FIGURE 12

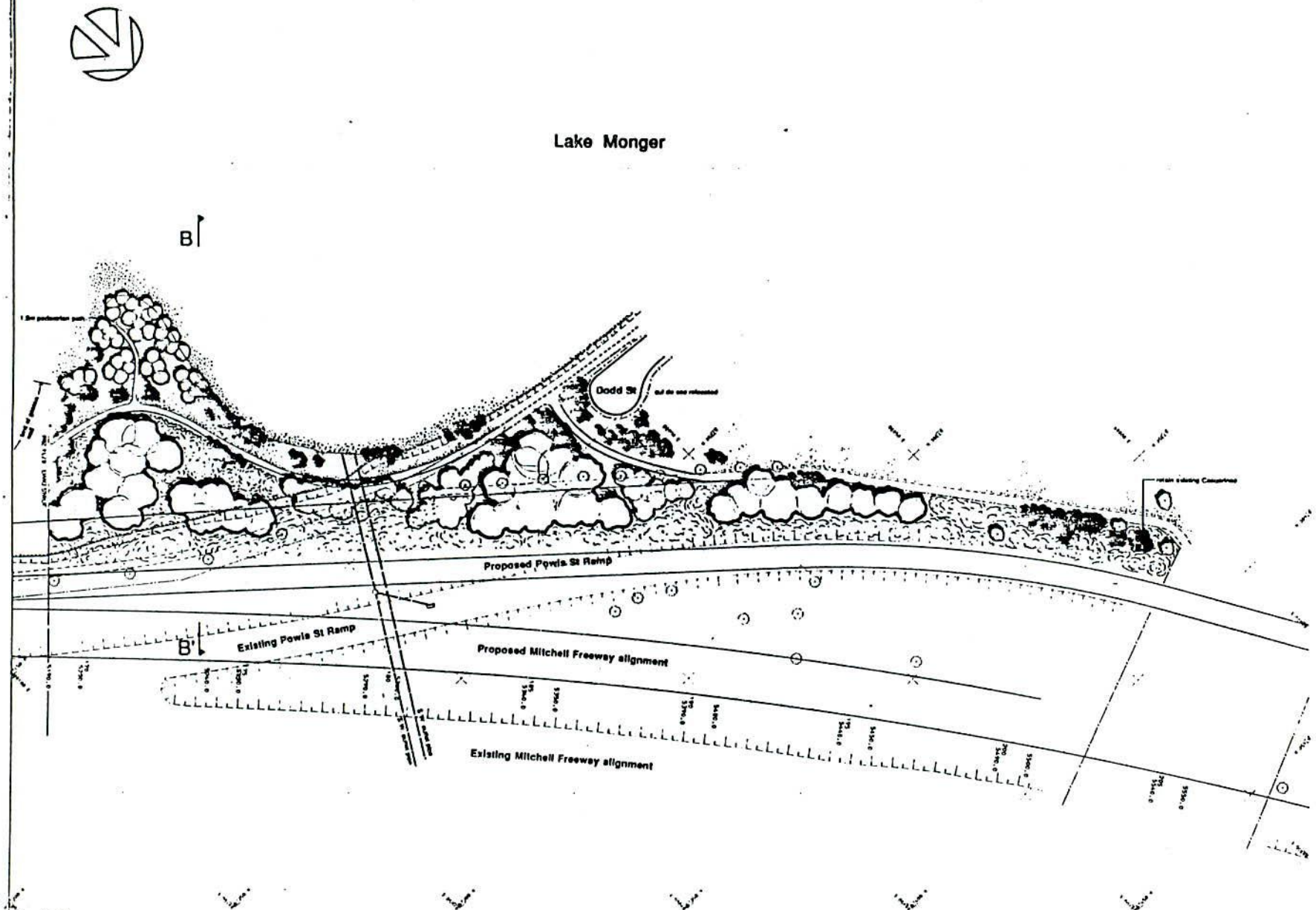


FIGURE 13

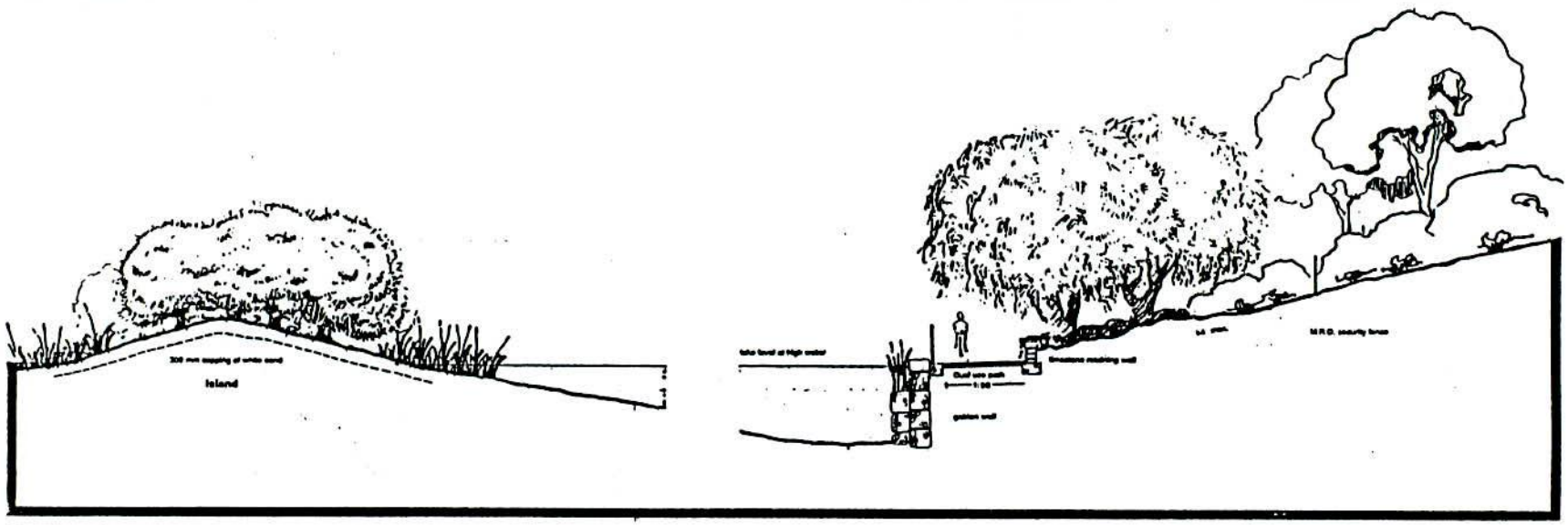
Blackwell & Associates Pty Ltd
Landscape Architects Urban Designers

BLACKWELL & ASSOCIATES 2017

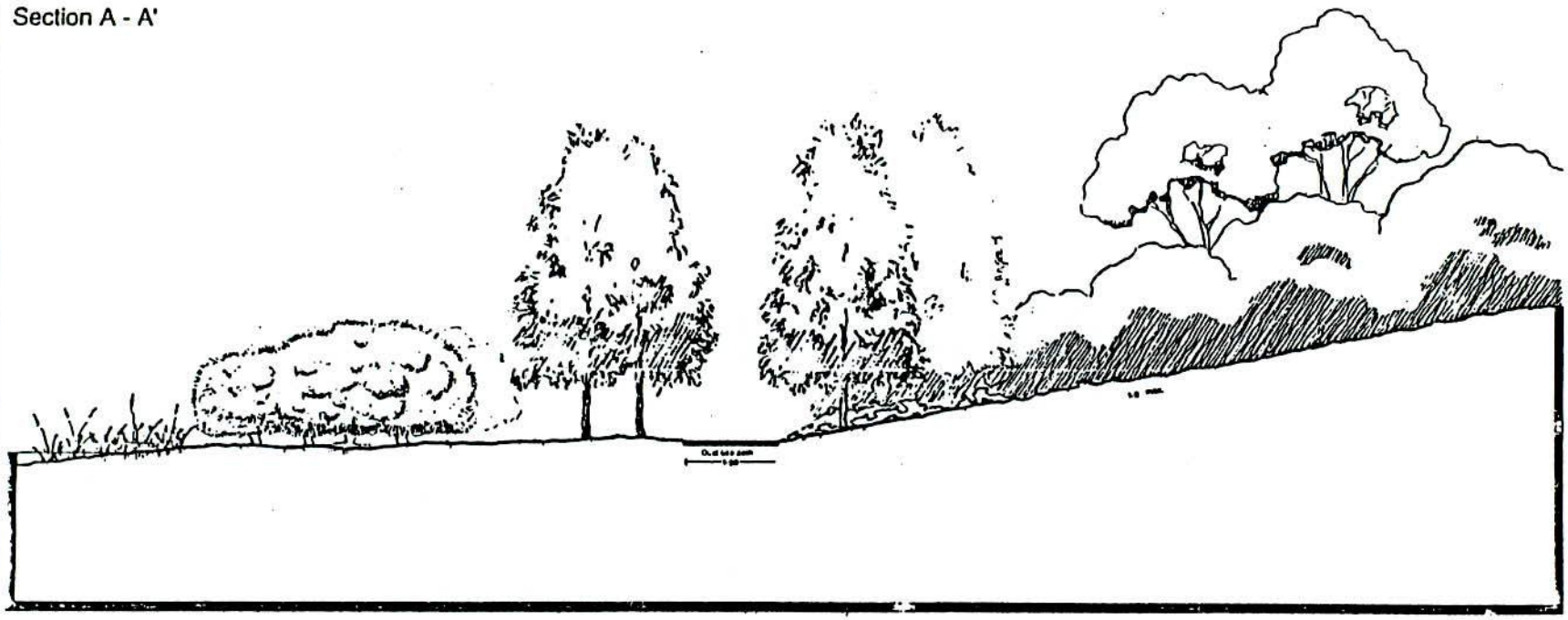
Mitchell Freeway Stage 3
Powis St. Ramp
Landscape Sketch Design 2/2

MAIN ROADS DEPARTMENT W.A.

8734-290



Section A - A'



Section B - B'

FIGURE 14

Blackwell & Associates Pty Ltd Landscape Architects Urban Designers	B1	BLACKWELL & ASSOC.	29/7	Mitchell Freeway Powis St. Ramp Landscape Sections	Stage 3 1/1
				MAIN ROADS DEPARTMENT W.A.	
				1488	8734-298A