K26 GROUP PTY LTD

The Lake Eyre Basin Development Proposal

EXECUTIVE SUMMARY

Large parts of Australia are subject to frequent and prolonged droughts which seriously hamper both economical and social development of affected areas.

This proposal describes possible engineering ways of improving the water balance of the Lake Eyre Basin. This basin covers one/seventh of Australia and delivers a significant part of the national agricultural produce.

The engineering solutions presented in this paper are based on application of the Overburden Slusher (OS), a dedicated earth-moving machine researched and developed in Australia.

The OS enables large-scale excavations. In a year, one OS unit can excavate over 250 km of channel with a volume of over 100 million cubic metres, at a very reasonable excavation unit cost.

The proposals included in this paper describe two possible applications of the OS:

1. Channel and off-channel water storages along the Diamantina, Cooper and other tributaries of Lake Eyre
2. The formation of high level flood refuges associated with the water storages

Preliminary considerations indicate that the engineering intervention into the hydrological regime of the Lake Eyre Basin could greatly increase the availability of water, especially in times of prolonged droughts. Further studies would be required to establish economic and social net benefits.

The Conclusions list benefits for particular States, and overall common benefits.

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Lake Eyre Basin Development Proposal

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1. INTRODUCTION

Recent droughts highlight the vulnerability of most of Australia to long-term weather fluctuations. This is acknowledged through the passing of the Lake Eyre Basin Agreement Bill in the Queensland Parliament in 2001, which ratifies the Lake Eyre Basin Intergovernmental Agreement made between the Queensland, South Australian and Commonwealth Governments. An associated specific concern extends to the Great Artesian Basin Rescue Plan within the Lake Eyre Basin, and which is currently the subject of a five year governments funded initiative.

It is widely expected that vagaries of weather are likely to continue to put more stress on semi-arid areas of Australia. Droughts are likely to be more frequent and last longer. Recharge events could be shorter and more violent.

Large volumes of water in Australia are available during sporadic flood events. They usually flow to inland terminal basins and evaporate. Some portion of these waters could be retained by engineering means, and used to improve the lot of people who work in agriculture, and the overall performance of Australian agriculture.

2. BACKGROUND

We previously circulated the discussion document "***The BOSMIN® Lake Eyre Development Proposal***" of 5th December 2002. This document summarises the several contributions received from those initially contacted, as detailed on the attached list, and we are most grateful for those contributions.

The circulation list is now modified to reflect the wider scope of the current proposal, and to include new contacts recommended by some of the previous respondents. A copy of this document is also available at http://www.bosmin.com/LEDP.pdf should you wish to draw the contents to the attention of others.

Of particular note are contributions and discussions with Dr Vincent Kotwicki - the author of "***Floods of Lake Eyre***" (web reference http://k26.com/eyre/) who has considered the initial proposals closely. Some of the following information is gleaned from his book, and he also provided the **Executive Summary** for this proposal.

This has been a privately funded project and has now reached its conclusion. We would be most interested to receive any further comments which might arise from these revised proposals.

Should anyone wish us to pursue particular aspects of the study in more detail, we will be happy to respond to a specific brief.

3. THE MAIN POINTS

1. The Lake Eyre Development Proposal is more pertinently extended to include the whole of the catchment basin, as shown in Figure 1, and is now referred to as the ***"Lake Eyre Basin Development Proposal"***. This region covers the jurisdictions of the Northern Territory, Queensland, New South Wales, and South Australia.

Figure 1. - Lake Eyre Basin showing Mean Annual Evaporation isometers

2. The Lake Eyre Basin is a vast catchment area (1.14 million km^2), occupies one-seventh of the Australian continent (14%), and receives an annual average runoff estimated at 20 Km^3 per year (25 Sydharbs). Of this quantity most is lost through seepage and evaporation, as typified in the Cooper Creek, see Figure 2, and also where the Diamantina degrades in the Goyder Lagoon.

Figure 2 - Cooper Creek Flood near Innamincka, May 1974

3. Currently, about 0.05 Km^3 per year is harvested within the basin for stock use while water quantities diverted for irrigation, etc. are insignificant.

4. There are opportunities to conserve some of the runoff water for further use through hydraulic management of the basin.

5. The Cooper Creek (Qld & SA), Sandover, Finke (NT), Georgina (NT & Qld), and Diamantina (Qld & SA), Macumba, Neales (SA) Rivers have the greatest potential for stream diversion and water storage reservoirs. See Figure 3.

6. The Overburden Slusher (OS) energy efficient earth moving machine concept, could be used to cost-effectively construct diversion channels, canals, and deep efficient storage reservoirs within the Lake Eyre Basin. (Refer **BOSMIN®**

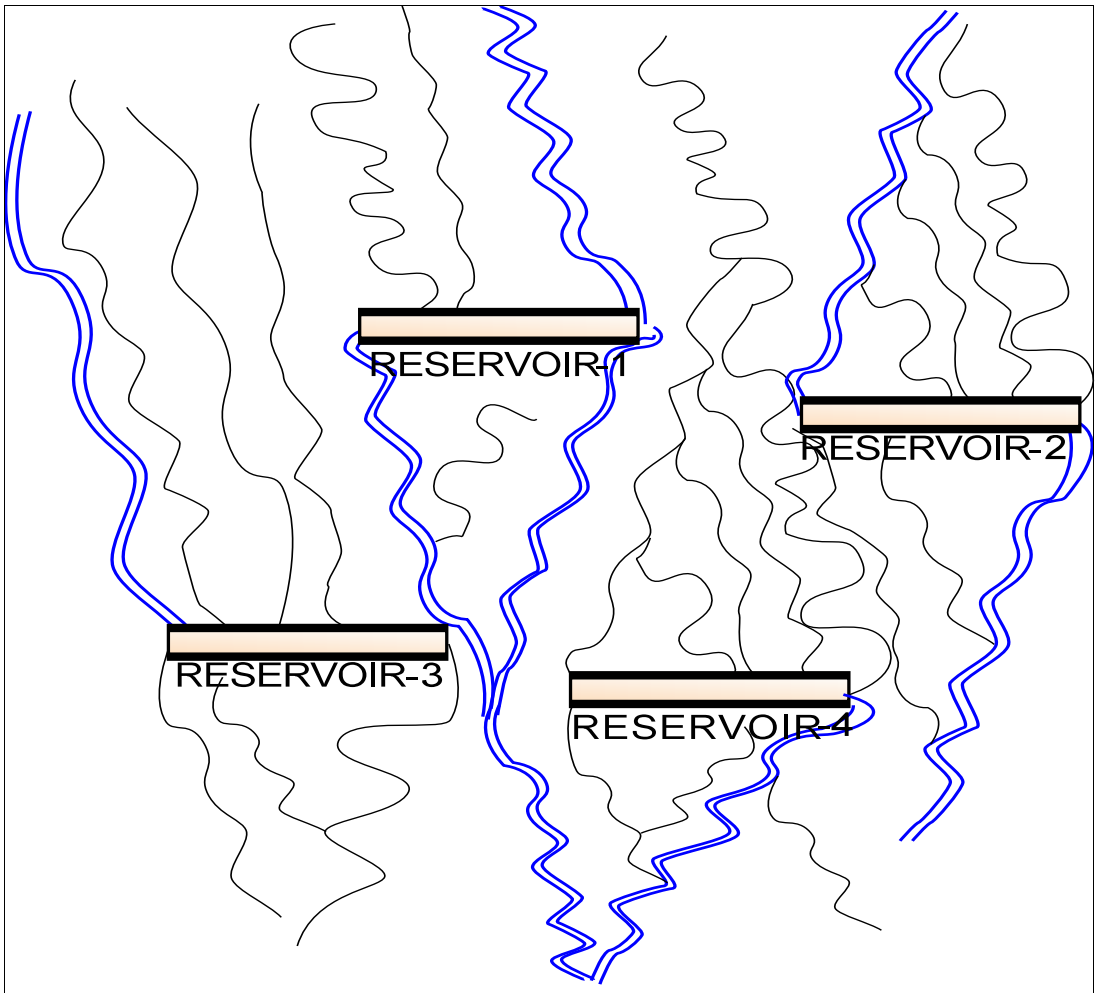

Figure 3 - Schematic braided streams filling en-echelon Reservoirs

Overburden Slushers Technical Bulletin #2 for details on the use of OS equipment as it might be applied to the open cut coal mining industry at http://www.bosmin.com/OS/os1.htm).

7. Developing large OS units would provide significant industrial activity resulting in machines suitable for applications in Australia and overseas.

8. This excavation procedure could provide substantially permanent water supplies to large arid regions within the basin at virtually any point along the major water courses - not only where suitable "dam" sites occur.

9. Reservoirs can be used directly as surface water or used indirectly to recharge underground reserves at appropriate sites.

10. The OS has the ability to dig under water. This provides an opportunity to deepen existing water storages without having to drain them first. It can also be used to "deslime" dams after heavy rain.

11. Another benefit of constructing storage reservoirs is the large associated levee banks. These provide wind protection reducing evaporation losses, and a permanent dry land base for mobile plant and fixed facilities, as well as high ground refuges for livestock and native animals during flood periods. This feature should reduce the incidence of stock and asset losses during floods and thereby improve our pastoralists' speed of recovery after flooding.

12. Draining the Diamantina river water through the Goyder Lagoon and into Lake Eyre would provide a substantially permanent brine water surface in the deepest part of the lake at Madigan Gulf, with associated wild life and tourism attractions.

13. The highest priority is to salvage fresh water in the Lake Eyre Basin currently lost through evapotranspiration and seepage.

4. STORAGE EFFICIENCY

Reservoirs dug with an OS and 25m deep have an average depth of 12.7m when full. This compares with the Menindie Lakes, see Figure 4, with an average depth of 4.5m. The annual evaporation rate in this region is 1.5m which illustrates the importance of using a deep efficient storage facility when conserving water in arid climates. The Menindie Lakes can be expected to evaporate water some 2.8 times faster than 25m deep excavated reservoirs.

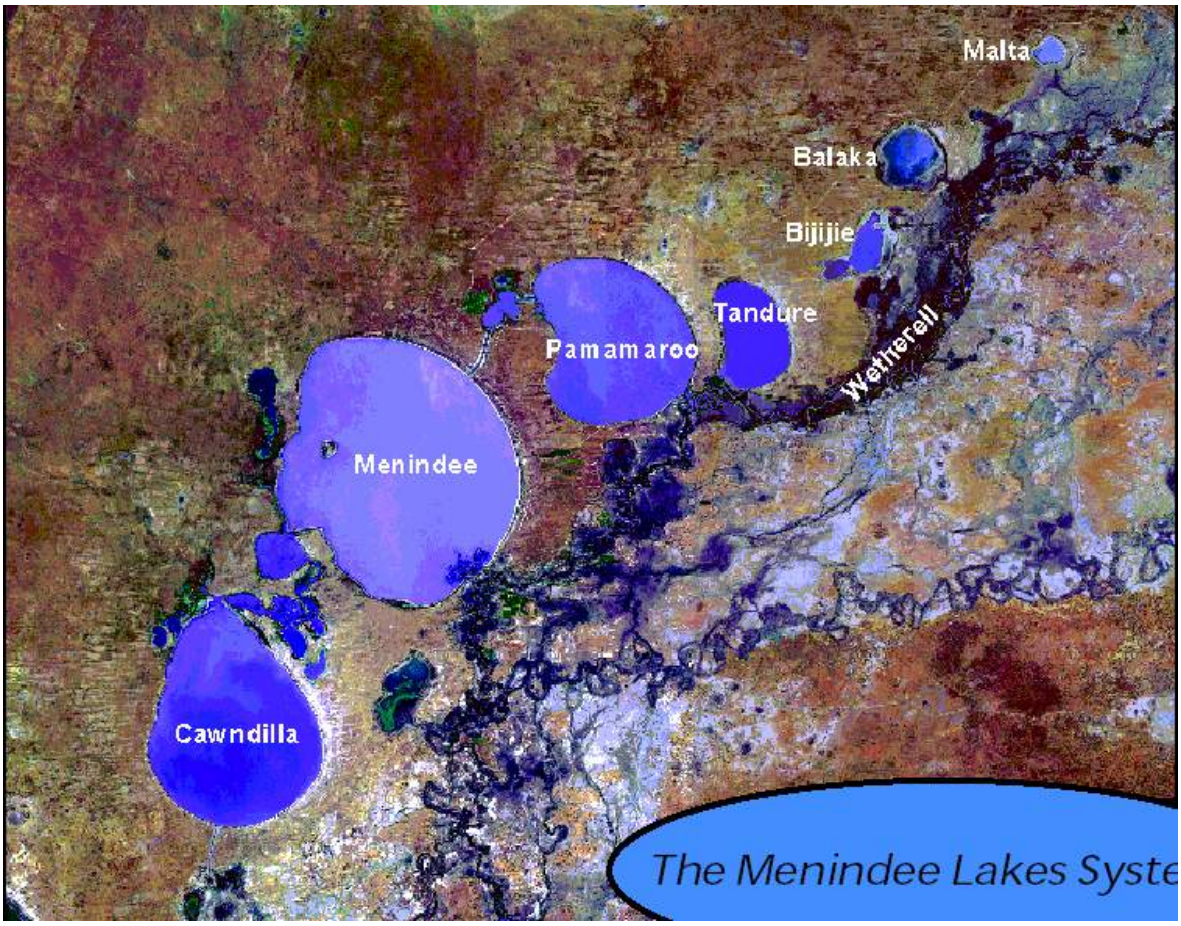

Figure 4 - NSW Menindie Lakes and Darling River.

Ref: http://www.dlwc.nsw.gov.au/care/water/rural_water_mngmt/pdfs/menindee_esd_project_sep02.pdf

Providing deep efficient water storages provides reliable water supplies for upstream users, and liberates excess water for further use down stream.

5. RESERVOIR EXCAVATIONS

It is proposed to dig a series of en-echelon dispersed reservoirs using **BOSMIN® OVERBURDEN SLUSHERS**. The reservoirs are suited to diverting flood plane water and storing it for subsequent use as schematically depicted in Figure 3. A typical cross section showing the construction procedure is shown in Figure 5.

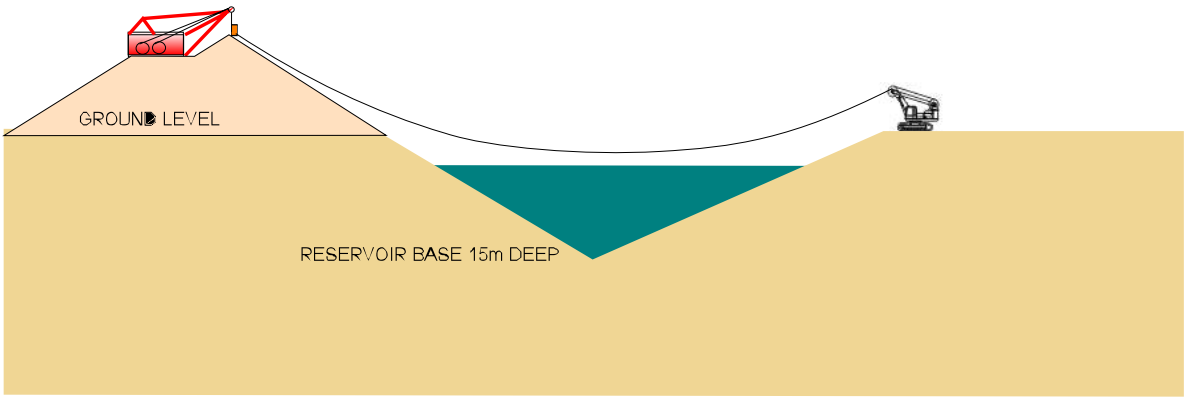

Figure 5 - Typical Reservoir X-section

The proposed Overburden Slusher (OS) system of digging uses a large mobile winch to pull an excavating hoe with the contained payload of earth, across a digging surface. A smaller mobile winch pulls the hoe back to the loading point. As the direction of pull is reversed, the hoe automatically empties by leaving the payload behind.

This system of stripping has been thoroughly researched over the past 20 years and found to be a technically superior way of moving earth is some applications. However, the lack of a suitable large new project has prevented prior commercialisation of the OS. **The Lake Eyre Basin Development Proposal** provides such an opportunity.

DIVERSION CHANNEL EXCAVATIONS

The OS can also be used to dig very deep lagoons, or diversion channels such as may be required to traverse the Goyder Lagoon, by stacking spoil on both sides of the excavation as illustrated in Figure 6.

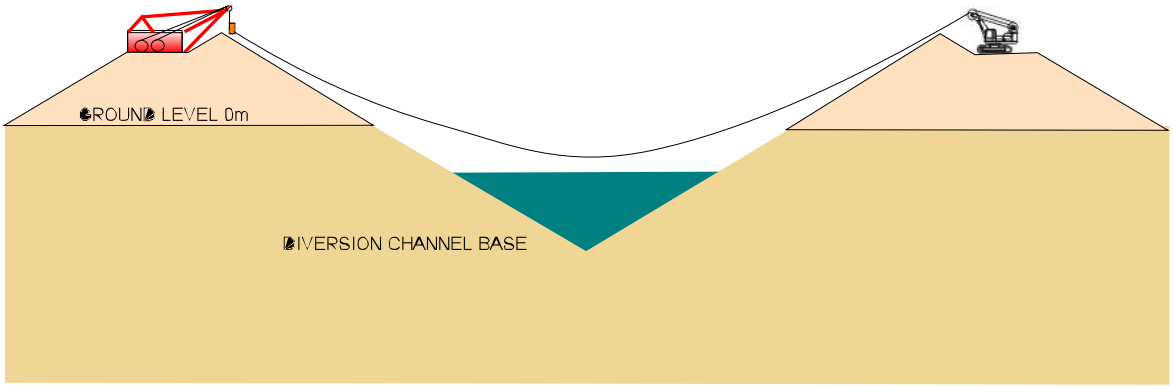

Figure 6 - Diversion Channel Construction Technique

6. THE OS UNIQUE EXCAVATING FEATURES

The OS system of digging includes some unique features:

- The payload never leaves the ground thereby eliminating potential energy losses, and obviating the need for a base plate or undercarriage mechanism to support the payload.
- The depth and transfer range of the equipment can be increased by using longer haul ropes.
- The equipment is fuelled by efficient electrical energy.
- The motive power plant remains stationary when digging. This feature eliminates the energy loss associated with transferring tractive effort through track or wheel systems, and it also avoids the energy otherwise lost in moving the power plant as well as the payload - particularly on an up slope.
- OS equipment can efficiently haul material from an excavation without the need of a formally constructed roadway.
- An OS can excavate below a water surface making it ideal for the proposed reservoir constructions as well as rehabilitating water storages containing excessive silt.

7. OVERBURDEN SLUSHER MACHINE CAPACITY

A large Overburden Slusher suitable for Diversion Channel and Reservoir construction tasks will have two mobile winches and a selection of hoes with a range of payload capacities. The Forward Winch has 18,500 kW (24,800 HP) installed capacity while the smaller Return Winch has 3,400 kW (4,560 HP). Suitable hoes vary in size from183 m^3 to 235 m^3 and when empty, weigh between 73 and 94 tonnes each.

Broad specifications for each of the major OS equipment items include:

FORWARD WINCH	
Overall machine weight	6,385 tonnes
Boom Length	66.2m
Base Length	35.0m
Base Width	27.0m
Stall Pull	7,026 kN
Tracks	8 off
Track Width	3.8m
Track Length	16m
Winches	4 off
Winch Drives	4 x 1,550 HP
Maximum Drum Velocity	15rpm
Drum Diameter	4.4m
Flange Diameter	4.5m
Face Width	5.65m
Rope Diameter	93.8mm
Active Rope Length 802m	

RETURN WINCH	
Overall machine weight	1,373 tonnes
(including 202 tonnes of stability ballast)	
Boom Length	35.4m
Base Length	19.5m
Base Width	14.5m
Stall Pull	3,013 kN
Tracks	2 off
Track Width	2.2m
Track Length	19.5m
Winches	2 off
Winch Drives	2 x 1,150 HP
Maximum Drum Velocity	65rpm
Drum Diameter	3.0m
Flange Diameter	3.4m
Face Width	2.9m
Rope Diameter	93.8mm
Active Rope Length 882m	

HOES	
183 cubic metre capacity:	
Length	7.44m
Width	9.92m
Height	2.48m
Tare Weight	73t
235 cubic metre capacity:	
Length	8.08m
Width	10.78m
Height	2.69m
Tare Weight	94t

Smaller OS machines can be built up from hydraulic excavator equipment and could be suitable for local government, or private landholder use.

Other project components which need evaluation for specific applications include:

- Site selection
- Survey and geotechnical studies
- Hydrology and hydraulic modelling
- Power, reticulation, and service supplies
- Civil Works
- Environmental studies and impact remedial measures
- Engineering design and construct
- Education and training
- Project costing

7.1 STORAGE RESERVOIRS

Storage reservoirs are constructed with all the excavated material stacked on one side of the void. Reservoirs 25m deep can be excavated using one OS machine at the rate of 58km per year (excavating 68 million m^3), and for 15m deep 280km per year (excavating 116 million m^3).

7.2 DIVERSION CHANNELS OR RESERVOIRS

The productivity from this sized OS was also computed using range diagrams showing spoil placed on both banks of the canal as illustrated in Figure 6.

The results show that a channel 20m deep can be excavated at the faster rate of 238 km per year using a single OS unit, and a 40m deep channel can be excavated at the rate of 116 km per year.

When used as a deep reservoir, this type of channel construction will include periodic "windows" through the upstream side levee bank to allow the flood waters entry to the excavation.

8. CONCLUSIONS

The Lake Eyre Basin Development Proposal provides different opportunities in different locations which can be usefully segmented by regions as follows:
Queensland has the most to gain in terms of water storage sites by virtue of having the largest portion of the basin, and to subsequently benefit their coal mining regions by introducing large efficient coal stripping equipment.
New South Wales occupies a comparatively small portion of the Basin, but has opportunities to apply the reservoir construction principles to the Darling River or other river systems when considering new water storage development, and to also benefit the open cut coal mining industry by introducing large efficient coal stripping equipment.
The **Northern Territory** has a large basin catchment area, and may usefully develop new population centres and new pastoral activities around permanent water supplies as well as review the opportunities for expanding existing developed areas.
South Australia occupies a large portion of the lower basin region where significant areas of dry lake beds exist. Increasing the efficiency of fresh water inflow to these areas could lead to some permanent lake water and reservoir storage opportunities. In particular, reclaiming water lost in the Goyder Lagoon would provide an average inflow of 0.5-1 km^3 to Lake Eyre, sufficient to provide permanent water in the deepest part at Madigan Bay, while hydraulic management of the Cooper and upper Diamantina rivers would add to the flow. This action would provide ecological benefits, local development, and add tourism potential. SA could benefit from more efficient use of water storage in the Darling River system thereby providing improved flow rates in the Murray River.

Common Benefits
All jurisdictions have some opportunity to benefit from;

- Providing a reliable water supply to outback locations and thereby reduce the impact of drought.
- Revenue raising through ongoing public use of the constructed reservoirs.
- Providing high ground refuges for plant, facilities and animals, thereby reducing the impact of floods.
- Enterprise development of OS excavation equipment leading to employment and export opportunities.
- Establishment of improved power distribution systems in regional Australia.
- Mineral deposit information gleaned from channel excavations.
- Upgrading land values by providing permanent water supplies, and providing governments or developers with improved land sale opportunities.

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