NEW SOUTH WALES
Department of Public Works

STUDY REPORT

Georges River–Chipping Norton Sand Extraction

Sydney July, 1975
This report was produced for the department by Messrs Soros, Longworth & McKenzie, Consulting Engineers.

It incorporates the results of studies carried out by departmental officers and by the Consulting Engineers.
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1.0 INTRODUCTION AND OBJECTIVES

1.1 Introduction

Sand deposits have been extracted for many years from the Chipping-Norton/Liverpool area of the Georges River. The extraction has been both by floating cutter-suction dredges and by mining from open pits in the dry.

As far back as 1967 it was realised that an extensive artificial lake could be created in the wake of the mining activities, turning a major eyesore into an attractive amenity. But the fragmented and often unco-ordinated powers of the various authorities has proved inadequate to achieve progress towards the desired end result.

The physical situation has now been reached where the surface area of water created by mining totals some 100 hectares. The surface area of the proposed completed lake would be about 150 hectares, so that in fact 70% of the final water area presently exists, making the formation of a lake the only really practicable environmental solution. The existing control and regulations result in unattractive pits dissected by roads and remnants of 2 chain river reserves etc. (see photo, Fig. 1) whereas the objective is to create a finished lake to a co-ordinated plan at minimum cost to the public (see frontispiece).

In November 1974, the Public Works Department commissioned Consulting Engineers Soros Longworth & McKenzie to obtain views and information from the sand-mining companies and to report on the physical and legal aspects of the problems involved in expediting the completion of the lake. The findings of this study are incorporated in this report. For the sake of brevity, where any specific reference is made to that report it will be referred to as the SL & M Report.

1.2 Relative Importance of Chipping-Norton Sand

The location of the study area in relation to Sydney and other sand deposits is shown on Figure 2. The latest output figures available from the Department of Mines are for 1972-73; current production seems to have levelled-off and would not differ greatly from these figures. With time the Georges River deposits will decrease in importance and the Nepean-Hawkesbury/Londonderry output should increase to compensate.
FIGURE 1 — SAND MINING AT CHIPPING NORTON — JANUARY 1975
<table>
<thead>
<tr>
<th>LOCATION</th>
<th>ANNUAL OUTPUT (tonne x 10^6)</th>
</tr>
</thead>
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<tr>
<td>NEPEAN HAWKESBURY</td>
<td>2.0</td>
</tr>
<tr>
<td>KURNELL</td>
<td>1.3</td>
</tr>
<tr>
<td>GEORGES RIVER (MAJORITY CHIPPING NORTON)</td>
<td>1.0</td>
</tr>
<tr>
<td>LONDONDERRY</td>
<td>0.4</td>
</tr>
<tr>
<td>NORTHERN SUBURBS</td>
<td>0.3</td>
</tr>
<tr>
<td>OTHERS</td>
<td>0.2</td>
</tr>
</tbody>
</table>

- Denotes sand mining area.
It can be seen that the study deposits provide almost 20% of the sand in the Sydney area. The deposits are not a high quality sand, but are strategically placed and the extractors have learnt to accommodate deficiencies by blending with sands from other sources.

The sand deposits are a valuable resource and it is to the advantage of the region that production should continue as long as practicable.

1.3 Objectives

The objectives of this study are: -

(a) To identify in a practical way the difficulties that have apparently prevented an orderly and integrated approach towards the desired lake amenity.

(b) To make definite recommendations and set up a timetable towards achieving the lake and foreshore parks and at the same time allow the region to use an important sand source.

(c) To examine broadly the engineering and related problems, discuss costs and funding and recommend a plan of action for engineering investigation, design and development.

(d) To identify matters requiring immediate and urgent attention.
2.0 SUMMARY AND CONCLUSIONS

2.1 The Problem

For a number of years the creation of a recreational lake of some 150 hectares in the wake of sand mining activities in the Chipping-Norton/Liverpool area of the Georges River has been mooted. But the involvement of two councils, some seven State authorities and several committees has, with ill defined and overlapping responsibilities, not surprisingly failed to achieve progress towards the desired end result.

From an historical situation where local farmers sold topsoil and sand to supplement their income, the position now involves principally two major public companies and one major private company, with an aggregate annual output approaching one million tonnes of sand, or almost 20% of the sand produced in the Sydney region.

In so far as water area is concerned, the lake is already 70% complete and unless immediate action is taken to plan and co-ordinate the mining activities towards effective development of the final lake, the situation is likely to provoke severe public criticism and censure.

Fortunately the remedy is essentially simple and fundamental to proper planning and control; the interests of the various authorities should be vested in a single authority, created with the aim of developing the lake as an attractive public amenity.

2.2 Legal Aspects

As the present situation stands, the councils have rights and powers of considerable importance with regard to public roads, foreshores, extractive industries, public recreation areas and also with regard to planning and zoning schemes. However many of these powers do not extend to the river bed and are subject to conditions of other Acts and Authorities. To create the total lake, power over the river bed is essential.

The Minister for Public Works is already charged with responsibilities and powers as Constructing Authority under the Rivers and Foreshores Improvement Act which are germane to the problem but which need to be expanded.

In summary, the considerable difficulties and uncertainties that could arise if it were attempted to carry out the lake works under existing fragmented powers, would be avoided by legislation creating a single "Lakes Authority". This authority should have at least the following powers within the area of the proposed lake scheme.
(1) Power to acquire any land by purchase or resumption.

(2) Power to determine the amount of compensation, if any, payable to those whose land is resumed.

(3) Power to resume and to close any public road and to determine compensation, if any, payable to Council.

(4) Power to resume any land set aside for public use which is not already vested in the Crown and to determine compensation, if any, payable.

(5) Power to require the removal and/or relocation of services and to determine compensation, if any, payable.

(6) Power to lease or otherwise dispose of land which may become vested in the "Authority" on such terms as it sees fit.

(7) Power to control all aspects of sand extraction.

(8) Power to take over from Council any existing agreements concerning extraction of materials and to determine compensation, if any, payable to Council.

(9) Power to authorise the extraction of materials from any land on such terms and conditions as it sees fit.

(10) Power to revoke any "Existing use" right to extraction brought forward from the time when town planning controls did not apply.

(11) Power to cancel or vary any permit or consent to extract materials should the conditions of such permit or consent not be met or should there be grounds to believe that extraction or restoration work will not be completed in a reasonable time.

(12) Authority to receive moneys from any source and to apply same to the purposes of the scheme. This would extend to works considered necessary to the scheme but lying outside the formal boundary of the lake area.

(13) The authority to prepare a detailed scheme for development of the area for approval by appropriate planning and environment Authorities.

(14) Authority to carry out all works pertinent to implementing the scheme and associated works.
In addition, the title to all land dedicated for public purposes shall be vested in the authority and be exempted from council rates.

and

The Rivers and Foreshores Improvement Act requires to be amended to make it clear that the Constructing Authority may approve excavation within 2 chains of the top of the river bank and that the provisions of the Act then apply to the new bank (if any) so created.

and

Where these powers may conflict with other Acts this Act shall prevail, binding on the Crown.

2.3 Practical Selection of Authority

The timetable for lake development falls into three main categories:

(1) Urgent control and co-ordinating of the current mining activities.

(2) Detailed planning and engineering works on the lake and foreshore lands including land acquisition, environmental and landscaping factors.

(3) Management and development of the lake and foreshore lands as an operating public amenity.

Consistent with catering for these differing stages, the legal and practical aspects of the lake development required and recommended are:

(a) That the necessary legislation be enacted as a matter of urgency along the lines described to permit a single authority to co-ordinate the lake development.

(b) That to avoid the difficult and unnecessarily expensive task of setting up a special engineering authority on a short-term basis, the Minister for Public Works would become the initial "Lakes Authority".

(c) That, upon completion of the lake scheme the "Lakes Authority" transfer the area to the Minister for Lands for continuing management. This could be done progressively as sections are completed.

The legislation would therefore be drafted in such a way that the Minister for Public Works became the "Lakes Authority" initially, and a special fund would be set up to receive funds, purchase land and so forth. As sections of the lake and foreshores were completed,
ownership and control could be transferred to the Minister for Lands. Upon completion of the Lakes Scheme the special fund would be wound up.

Chipping-Norton Authority

Although it is recommended that the work be done by an existing Authority, it is also suggested that a local identity be given to the project. The name "Chipping Norton Lake Authority" is suggested.

2.4 Present and Future Sand Extraction

Existing agreements between the extracting companies and the Councils impose arbitrary depth limitations to the dredging which are somewhat above the sand basement. However, as the sand is a useful resource to Sydney as a whole, there is no reason why the sand should not be completely extracted in forming the lake, subject to bank stability. Study of boreholes and other available data suggests that permission to dredge to -17 m below water level (mean) would ensure that virtually all economical sand could be recovered. This depth of lake should be compatible with environmental considerations, remembering also that there will be many areas remaining shallower, where deposits are not economic to -17 m.

With reference to Figure 17, the following is a summary of reserves and estimated value based on current prices. This information is expanded in the body of the report - see Table 1: - Page 56

<table>
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<th>Saleable Product (tonnes) x 10^6</th>
<th>Waste (tonnes) x 10^6</th>
<th>Estimated Gross Value $ x 10^6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recoverable within suggested lake shoreline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) with no islands - 11.0</td>
<td>2.4</td>
<td>34.7</td>
</tr>
<tr>
<td>b) with islands left as shown - 9.0</td>
<td>2.0</td>
<td>28.7</td>
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But of the 13 to 14 million tonnes of total product (saleable plus waste) available in the lake area, only 6 million tonnes is mineable under existing terms and conditions. The balance is in "frozen reserves" contained in the 2 chain river bank reservations, roads, river bed and other small areas. The release of these frozen reserves are crucial not only to the proper completion of the lake, but also as a significant inducement for co-operation from the mining companies, and as a source of royalty revenue; a royalty of 40 cents per tonne (plus provision for inflation) has been suggested as equitable by the SL & M report.
Planning disposal of waste material requires urgent consideration in conjunction with the operating companies if its potential for assisting with the creation of the lake is to be properly utilised.

Subject to some reservations, the mining companies have indicated a general willingness to assist with the formation of the lake. But they stressed they were tired of dealing with a multiplicity of authorities and an absence of proper guidelines; their unanimous preference was for a single authority and a proper plan of action towards the final goal.

2.5 Timescale

Whilst some of the existing agreements set upper time limits, the addition of the "frozen reserves" to the system may extend these times. Also any assessment of time involves predictions of future demand. With these qualifications, the following overall completion dates have been calculated:

- Reserves as currently available - completion by 1981
- As above plus roads and easements - completion by 1984
- As above plus river and 2 chain banks - completion by 1988

Although the absolute completion of mining is going to take some 13 to 15 years, the development of the lake and parklands should proceed to plan in parallel with the clean-up dredging. Already about 70% of the final water area exists, and with the removal of Epsom Road (see plans) a large body of the water will become available for use. Thus public usage could be phased-in within a relatively short period - say 3 years.

2.6 Forming the Final Lake

With the opening up of the full lake, the resulting wave action will require attention to bank stability.

Much of the existing vegetation on banks and the 2 chain reserves is attractive and should be retained as far as possible (see photographs in Section 6).

In addition, it has been suggested that some remnants of the 2 chain strip be left as islands, or else islands be created or extended from waste products. Islands would not only make the lake more attractive, but also reduce wave action and protect banks susceptible to wave undercutting. The layout is shown by Figure 11.

The most economical and attractive method of bank protection would be to promote stable beaches, either allowing them to occur naturally, or shaping them with waste product and second-grade sand. Groynes, stone or concrete walls or sheet piling would also be required in some areas, (see Figure 24).
Immediate action is required to control and coordinate the extraction towards achieving these aims, before the current mining outstrips the opportunities.

Concurrently, planning of all aspects of the lake would take place including:

- Environmental studies and scenic planning
- Hydraulic engineering
- Bank protection and beach design
- Staged development for ultimate land use of foreshore areas

Under the proposed legislation the development would be under the Chipping-Norton Lake Authority, being the Minister for Public Works for engineering, planning and control of extraction and transferring to the Minister for Lands in the final phases.

Preliminary engineering studies have indicated that there are not likely to be any serious effects on flooding or pollution levels by the creation of the final lake, but further investigation and study is required. Although not directly connected with the lake proper, some bank protection might be required downstream in the Milperra area, and some upstream works will be necessary, the ageing Liverpool weir being one problem.

2.7 Costs and Funding

Funds are required to develop the lake and foreshores. On present costs the order of magnitude of these funds are:

- Land purchase = 1.0
- Engineering and extraction control = 1.2
- Investigation and Model Studies = 0.2
- Beach Formation and bank works = 1.6
- Downstream Works = 1.0
- Upstream Works = 1.0

$6.0 million

The nature of the development is such that the project can be at least partly self supporting. The sources of revenue could include:

(i) Grant or Subsidy by Federal Government
(ii) Present funding arrangements for the purchase of County Open Space Land
(iii) Donations by mining companies
(iv) Royalties or taxes on sand mined
(v) Contributions from local Councils (ratepayers money)
*(vi) Lease or sale of land to private enterprise: club, motel, etc.
*(vii) Licence fees for operating kiosks, boat hire etc.
*(viii) Entrance charges
(ix) Tax savings shared between companies and the authority
*(x) Use of land for State institutions

*Subject to the concurrence of the Minister for Lands.

The exact total from these sources is difficult to assess, but should aggregate in the range of $2.5 to 5.0 million for capital work over the next 10-15 years, plus future annual rentals etc. contributing towards operating costs.

Assuming $3.0 million as a conservative estimate from such revenue, a cash flow (Figure 27) has been prepared as a guide to the pattern of funding required. These are present costs with no allowance included for inflation.

2.8 Conclusion

The sandmining at Chipping-Norton has outstripped past efforts at co-ordination and unless urgent action is taken to charge a single authority with the goal of creating an attractive and useful lake, it is hard to see a satisfactory amenity being developed in reasonable time and at a reasonable cost to the community.

This study has uncovered no significant legal or technical difficulties in the path towards completion of the lake.

It is concluded that the principal recommendations of this report, as summarised in Section 2.3 and expanded in Section 4, should be implemented as quickly as possible.
3.0 HISTORICAL BACKGROUND

3.1 Lansvale Area

There is no evidence of extraction in this area prior to 1950. During 1950 a Mr. Elijah Smith commenced excavation of topsoil from his property at Beach Road and Howard Street (Fig. 3). His subsequent interim development application to Fairfield Council to legalise his soil removal activities was declined but Smith appealed to the Minister for Local Government and was eventually granted permission to remove soil subject to certain conditions. These included executing a deed with the Fairfield Council to limit extraction to only four feet of topsoil and observe certain distances of extraction from river, road and adjacent properties.

These early activities were confined to removal and sale of topsoil only. When it was apparent that commercial sand deposits were located beneath the topsoil, a private company - Hollywood Sands Pty. Ltd. purchased Smith's property. An apparent defect in legal drafting of the deed between Smith and the Fairfield Council did not bind the new owners. This and the subsequent suspension of the County of Cumberland Scheme on 26th May, 1961, had the effect of giving Hollywood Sands existing use rights to any activity coming under "removal of soil", but without the restraints imposed on Smith or by town and country planning legislation.

In this situation the only remaining direct restraint was through the Rivers and Foreshores Improvement Act which applies to excavations within two chains of the top of a river bank. In practice this Act was not fully effective and for the most part there were insufficient grounds to warrant action. Steps taken by the Minister for Public Works who administers the Act were limited to instructing the Company to restore a breach in a river bank levee on the Company's land. This was done and subsequently washed out in a flood. Legal opinion at that time was that although it was very probable that the damage caused to the levee was wholly or partially attributable to the excavation carried out by Hollywood Sands it was doubtful that the Minister could enforce a directive to Hollywood Sands to restore the banks.

The gradual extraction of sand from this property during the period 1955 to 1971 can be seen in Figures 4 to 9.

3.2 Chipping Norton Area

The Chipping Norton area was originally a primary producing area. The main activities were associated with vineyards and orchards. But prior to the introduction of the County of Cumberland Planning Scheme on 27th June, 1951, soil was being extracted for sale from a number of properties.
LEGEND.

- Land portions with soil extraction rights prior to 27-6-1951.
- Hollywood Sands Pty. Ltd. - original workings. Formerly owned by E. Smith.
- Outline of area adopted by Liverpool Council (1962) for development of a lake.

HISTORICAL DEVELOPMENT

FIGURE 3
These properties then had existing use rights outside of Liverpool Council's control. Extraction could proceed over the whole of the lots and to any depth subject to no erosion subsidence, or damage resulting to adjoining properties, public roads or being within two chains of the river bank.

In 1958 Liverpool Council approached the Department of Public Works to allow part excavation of the two chain strip of the river bank in the vicinity of portions 394, 350 and 393, then owned by Messrs M. Leonardi and M. Canceri (see Fig. 3). It would appear that the owners had been carrying out unauthorised sand extraction for some time prior to this date (see Fig. 4). The owners had agreed to transfer ownership of the land to Liverpool Council for purposes of reclamation with garbage provided that they could firstly, secure permission to carry out soil removal on the balance of the remaining soil deposits of the lots at that time and secondly, Council could successfully negotiate with the Department of Public Works for the part removal of the two chain river bank in the area. The transfer was to be on the basis, inter alia, that the owners paid no royalties or rates while soil extraction activities were carried out. Most soil removal had at this stage only been to a depth of approximately four to eight feet below natural surface - i.e. in the dry.

In September, 1959 the Minister gave his consent to the removal of the river bank in portions 350, 394 and 393, to within 66 feet of high water mark, on the basis that back filling and compaction of garbage would proceed at a rate not less than the rate of excavation and in a direction away from the river. The extent of extraction at this time is shown in Fig. 5.

However in February 1962, Liverpool Council advised the Department of Public Works that it had not proceeded with acquisition of the land and the matter was suspended. Apparently local residents had objected on the grounds that the deposition of garbage might cause fruit fly in their citrus trees.

It was during 1962 that the first significant attempt was made to rationalise the situation and credit is due to the Liverpool Council in adopting a "Lake Area" and in granting uniform approvals to extract within the area shown in Fig. 3, such approval being on the basis of an agreement between the owner and Council wherein the owner undertook to give the land to Council after the elapse of ten years or when the soil had been extracted to a depth 20 feet below normal river level, whichever occurred first.

Whilst these agreements undoubtedly improved the situation there were still practical inadequacies and the problem of existing rights.
In dialogue with the Council the Department of Public Works was not opposed to the principle of the lake, but would not consider consent to any excavation within 2 chains of the river bank until such time as Council submitted a detailed and fully thought out plan of implementation for the lake which would satisfactorily ensure that the lake foreshores would be constructed to a satisfactory standard even in the event of a number of contingency conditions. This matter between the Department and Council remains unresolved to the present time.

Despite these agreements and the constraints implicit in the Rivers and Foreshores Act, the real situation did not provide effective overall control, and distances from roads and private properties were not always maintained, while reference to recent photographs (e.g. Figs. 8, 9) show clearly that in one way or another the 2-chain barriers have "disappeared" in many places, probably due to extraction weakening the barrier and flood conditions breaching the weaknesses.

It became clear that despite the good intentions to develop the lake, no real progress was being made save that the water body was slowly but surely appearing in a fragmented and unattractive fashion due to the ineffective controls and lack of co-ordination of the extractors. There were also no royalty payments or other sources of funds occurring for the lake development. In 1967 the Georges River Extractive Committee was set up to attempt to resolve the problems on both sides of the river.

3.3. The Georges River Extractive Industry Committee

This Committee was an inter-departmental committee established by the Minister for Public Works and the Minister for Local Government. The Committee was composed of representatives from the following authorities:

- Department of Public Works
- Maritime Services Board
- Department of Lands
- Department of Local Government
- State Planning Authority of N.S.W.
- Liverpool City Council
- Fairfield Municipal Council
- Bankstown Municipal Council

The Committee held its first meeting on the 11th December, 1967.
The following are comments on the significant findings and recommendations of the committee:

(a) There is no co-ordinated final plan for the area. Sand extraction is being determined by each operators immediate needs and presumably operators would cease activities when the extraction becomes uneconomic. Liverpool City Council had granted certain approvals and required certain operators to enter into agreements (i.e. not all the operators could be forced into the agreement). This in itself represented a patchy control which nullified the limited control that could be exercised under the Council's agreement with the operators.

(b) There are insufficient statutory powers vested in any single authority for controlling the sand extraction activities towards the development of an acceptable lake.

(c) The lake concept, whether desirable or not, has hitherto developed unplanned and unco-ordinated to such an extent that a lake is the only feasible solution.

(d) Any river bank erosion of Georges River, no matter whether upstream or downstream, is likely to be attributed to the lake and it could be difficult to prove that the cause was due to other factors. The implications are that maintenance expenditure could well extend outside of the direct lake area.

(e) The Committee recommended, as a matter of urgency, the formation of a single trust or body to control the activities of the sand extractors. This body should possess considerable powers to enable enforcement of consistent controls necessary to ensure a satisfactory lake and satisfactory facilities for funding the development of the lake.

(f) The Committee recommended the introduction of new legislation. The purpose of the new legislation would be to firstly, overcome some potential weaknesses in the Local Government Act as regards its effectiveness in preventing and controlling extractive industries and secondly, to ensure that planning consents to extractive industry were not made without the concurrence of the Public Works Department, the latter being the public authority best equipped to deal with river, tidal, hydraulics and engineering contracts administration as well as having statutory responsibilities under the Rivers and Foreshores Improvement Act.
The sand extracted is used for concrete making and as such is a valuable resource contributing to the development of the city of Sydney. The Committee concluded that the extraction of the sand was in the best interest of the general public.

The proposed lake boundary (see Fig. 10) was recommended as temporary and amendments could be expected in the light of investigation findings and circumstances as they arise.

The report of the Committee was issued by the State Planning Authority; the then Minister for Public Works receiving a copy on 6th September, 1972.

3.4 Recent Developments

On the Chipping-Norton side, the mining activities have increased in scale and presently all the extraction is by two public companies, Farley and Lewers, and Monier. A third company, Blue Metal Industries owns land for sand extraction, but has assigned the processing to Monier. Only three portions of land within the lake area remain in private ownership, but the owners (Rushton Bros.) have assigned the mining rights to Monier who in turn are operating by agreement with the Liverpool Council.

On the Lansvale side, Hollywood Sands Pty. Ltd. are now the only operators. At the time the Committee was in discussion the State Planning Authority entered into a deed of agreement with Hollywood Sands Pty. Ltd. granting development consent to carry out extractive industry in an area of Fairfield Municipality extending from the Hollywood Sands existing pit, situated between Howard Street and Beach Road, to the junction of the Georges River with Prospect Creek. Hollywood Sands now operate under deed of agreement with the Fairfield Council and pay royalties towards the lake's development.

Since August 1973, the Public Works Department has been involved primarily with the Lansvale area, to ensure that this most recent area to undergo extraction would be controlled in a manner cognisant of the long term needs of the lake scheme. The recent extent of sand extractions, including Hollywood Sands extraction area, can be seen in Fig. 9.
LAKE BOUNDARY AS PROPOSED BY G.R.E.I.C.

FIGURE 10
4.0 STATUTORY POWERS

4.1 Introductory Remarks

A number of statutory authorities have degrees of control over the area in general and the sand mining in particular. These include:

<table>
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<th>AUTHORITY</th>
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<td>Local Councils (Fairfield, Liverpool, Bankstown)</td>
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<tr>
<td>Planning and Environment Commission</td>
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<td>Metropolitan Water Sewerage and Drainage Board</td>
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<tr>
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<td>Mining Act</td>
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Each authority has had only a limited degree of control and consequently timely and satisfactory decisions to overall problems have not been possible. This has not been satisfactory either to the extractive companies or the community.

As described in the previous section the industry has developed from local farmers digging and selling topsoil, to the present situation where three major companies are mining on a large scale. Whilst the councils have monitored the operations in the interests of their districts, such unilateral control has not provided the broad planning and uniform agreements now needed.

Neither have the authorities necessarily had a common goal; as an example it is understood that recently the State Pollution Control Commission insisted on actual re-instatement of a portion of 2 chain reserve barrier, while the Liverpool Council are understood to have opposed the restoration.
The SL & M report found that the mining companies are apparently willing to co-operate with authorities and would have welcomed a co-ordinated plan towards the lake formation and even now (although in some areas there is little sand remaining) they would be prepared to assist in shaping the final lake. However the miners are somewhat frustrated and embittered at having had to deal with so many and sometimes conflicting authorities. This has made them sceptical of the realisation of the lakes scheme.

It is not meant to imply that the authorities have been difficult to deal with and it is fairly clear that the miners have from time to time infringed requirements while the authorities have apparently taken a reasonable attitude in most cases. The real problem is that interaction between several State authorities, local councils and private companies in a changing situation is too cumbersome to be practicable. Also because of so many departments and separate actions by the local councils, there has never been a realistic set of overall guidelines for the extractive industry to work to.

In so far as the lake scheme is concerned, the past difficulties should be acknowledged, but there would appear to be nothing gained by recriminations, other than to use experience as a basis for setting guidelines to complete the lake to plan and as an extension, to form a working basis for other areas to be mined.

In summary, while there is an over-riding need to protect the public interests vested in the State authorities and local Councils, there is a strong practical need for a more realistic approach, for example: -

(a) The interests of the various authorities should preferably be vested in one overall authority which would deal directly with the problems of the extractive industry. This body would of course make reference to the other authorities in some matters, but there should be a system to ensure speedy routine decisions.

(b) There should be realistic agreements and guidelines for the industry to work to. In the Chipping-Norton case the need for an overall plan of completion for the lake is now of the utmost urgency.

4.2 Rivers and Foreshores Act

The Rivers and Foreshores Improvement Act 1948-1955 is of crucial importance to this study. The Act creates certain limited powers of construction and limits generally any construction involving the banks and/or the bed of the river. Basically two organisations may engage in such construction:
(a) The Minister for Public Works for any work not being for the purpose of preventing the inflow of sea water or saline water into the course of a river to enable water to be supplied to rural lands or for irrigation.

(b) The Water Conservation and Irrigation Commission for Works not covered by (a).

The Act further provides in Section 23 A(1) :-

"No owner or occupier of land or other person whomsoever shall, except with the permission of the Constructing Authority -

(a) make or cause or allow to be made any excavation on, in or under any land situated within a distance of two chains measured horizontally from the top of the bank of a river;

or

(b) remove or cause to allow to be removed any soil from the bank of a river or from any land situated within a distance of two chains measured horizontally from the top of the bank of a river".

This provision is unsatisfactory for a number of reasons: -

(1) It operates as a restriction on the user of the land.

(2) Breach of its terms is punishable by a fine small enough to bring the offence within the jurisdiction of a Court of Petty Sessions. This operates as no effective deterrent when large sums of money are involved.

(3) The section does not apply to lawful mining operations, nor does it restrict statutory bodies or councils.

(4) It creates a "no-man's land" between land and water which is in fact vested in the holder of the fee simple but controlled in certain respects by the Constructing Authority.

As a consequence, it will be necessary to consider the powers of the various authorities in the light of the restrictions created by this act.

4.3 Crown Lands Consolidation Act

Another Act of considerable importance to this study is the Crown Lands Consolidation Act 1913 (as amended). This Act provides that the Minister for Lands may
dedicate certain lands for uses set out in Section 24 thereof including use as recreation grounds or "for any other public purpose" and provides a procedure for dedication. The Act allows the Minister to appoint trustees (see Section 26) charged with the care and Management of dedicated lands having the power to make rules and regulations with respect thereto.

The Act goes on to vest land under the sea, any harbour bay, lake, river, creek estuary or navigable stream in such a manner as to allow the Minister for Lands to lease it for the erection of wharfs, jetties, ports, docks etc. (Section 74). It further provides (in Section 235 A (8): -

"Where under the Crown Lands Act the bed of any river has been reserved from sale or lease no person shall by reason of his being the owner of any land adjoining the river which has been subsequently alienated as bounded by or by reference to or by the margin or bank of the river or by metes expressed or shown to run to the river or to the margin or bank of the river be entitled to any rights of access over or to the user of any part of the bed of the river other than to such rights as are or have been acquired either before or after the commencement of the Crown Lands (Amendment Act 1931) under or pursuant to the Water Act; 1912-1930".

The effect of this provision with regard to the subject land is that the title to the bed of the river is vested in the Crown. Section 235B further provides that no title shall by reason of adverse possession be allowed to be asserted or established as against the Crown or Trustees holding the land for any public purpose which (inter alia) has been dedicated for any public purpose or set out as a road under any Act.

Thus the land concerned in this study fits into 4 main categories.

1. The bed of the river vested in the Crown.

2. Freehold land bordering on the river which is subject to the provisions of the Rivers and Foreshores Improvement Act (the two chain reserve) vested in the freeholder but some control of the use of which is in the hands of the Constructing Authority.

3. Freehold land not subject to the Rivers and Foreshores Improvement Act bordering on the river.


As well as this, special consideration must be given
to any public roads within the ambit of the proposed scheme.

4.4 **Navigation Act**

It must be noted that any matter involving construction on or near navigable waters is subject to the control of the Maritime Services Board acting pursuant to its powers under the Navigation Act.

4.5 **Local Councils**

Two Councils have control over the subject land:

The Fairfield Municipal Council as to lands north of the river and the Liverpool City Council, as to lands south of the river. Their rights with regard to the subject land are set out in the Local Government Act 1919 as amended.

Land on the boundary of two council areas (as the subject land is) is included within the area controlled by the councils, if it is reclaimed from tidal waters, situated under tidal waters or on the shore or on or below the high water mark or below the margin of tidal waters (see Section 15) so that effective control of the river bed within the confines of the Local Government Act would seem to be vested in the councils.

However, considerable doubt exists in this regard following the decision in *Humby v Woollahra Municipal Council*. The digest report simply states "It is open to grave doubt whether the County of Cumberland Planning Scheme can lawfully operate to restrict development below the highwater mark for Port Jackson".

This case may be distinguishable from the circumstances surrounding the subject land for several reasons:

1. It involved a County Council scheme.
2. The decision may only relate to this particular scheme; or to schemes in general.
3. The land in question was within the Port of Sydney.

The case serves to illustrate the conflict of powers involved.

The Councils have important powers with regard to zoning (see Section 309) the preparation of planning schemes (see Part XIIA) and have the care control and management of public reserves not vested in others or vested in the Councils by order of the Governor (Section 344).
The Councils also have extensive powers relating to public roads. These are vested in the Councils in fee simple (Section 232) reserving thereout such minerals as are reserved to the Crown. The Crown is bound by such ownership (Section 232(4)). None of the roads in the immediate vicinity is a main road. The nearest such road is Newbridge Road (main roads are vested in the Commissioner for Main Roads). The Councils' power allows for the alienation of some of the soil constituting the roads (see Section 486) and the Councils have the right to claim compensation which is calculated as a sum equal to the amounts spent by Council Maintaining the road (Section 233(5))

Section 233 of the Act further provides:

"(7) A person shall not use any public road or the soil thereof or permit the same to be used in derogation of or so as to affect the exercise of the rights or powers of the Council".

The Councils have in addition powers under Section 249 of the Act (inter alia) to:

"(66) Regulate the excavation on any land adjacent to a public road of any quarry pit or the like in such manner and to such extent as is necessary to secure the support of the road and anything lawfully thereon or therein for the protection from injury of persons using the road".

This is a very wide power which is further extended in Section 277. This section gives Councils power to make ordinances (inter alia) for:

"(1) (d) the control and regulation of the digging up of a public road by any statutory body;

and

"(1) (LL) preventing and regulating the excavation of sand from land adjacent to or in the vicinity of any public road in cases where such excavation is below the level of a road and constitutes a disfigurement of the locality or danger to the public on a public road".

This is a specific head of power allowing the Councils to control extractive industry in the subject area, although similar power might also be derived from the zoning powers and town planning powers.

Included in the Councils' powers with respect to town and country planning in Section 342G is a provision that planning schemes may provide for:

"(O) preservation or acquisition for public access use and enjoyment of the foreshores or banks of the ocean harbours, rivers, lakes,
lagoons and the like and conservation of the natural beauty thereof".

The Councils also have the power to acquire land under Part XXV of the Act for undertaking road construction, demolition and building (Section 321) and may with the consent of the Minister regulate the cutting of any channel or the doing of anything on or adjacent to any land acquired by the Council or under the care control and management of the Council which causes or is likely to cause the waters of any creek, river, canal, drain, reservoir, pool, marsh lake or lagoon to flow in or upon or through such land. (Section 352A). They have power to prevent floods and to allow for drainage (Section 406) and to prevent obstruction of rivers and watercourses (Section 409) and may engage in the destruction of aquatic pests (Section 557) and may construct, maintain and sublet public wharves (c.f. Section 74 Crown Lands Consolidation Act) outside the Port of Sydney.

The Councils may by agreement carry out any work on behalf of a constructing authority (Section 528D) and may lease property (subject to Section 519) or enter contracts for any of the purposes of the Act (Section 519) or enter joint action agreements with other Councils (Section 521).

Summarised briefly, the Councils have rights and powers of considerable importance with regard to:

(a) public roads
(b) foreshores
(c) extractive industries
(d) public recreation areas

and some limited powers, not clearly defined with regard to the river bed and in addition with regard to zoning and planning schemes.

The limits to the Councils' powers may be summarised for our purposes as follows:

(a) they do not have complete control over the river bed;
(b) they are subject to the Rivers and Foreshores Improvement Act; and
(c) many of the powers they depend on or act upon are either concurrent powers also vested in other bodies (e.g. Minister for Lands or Maritime Services Board) or depend on delegation from other bodies (e.g. powers under Section 528D);
(d) since the river is on the boundary of two Council areas*, considerable doubts as to the responsibilities of both would arise if the bed of the river were altered and also the respon-
(d) responsibility for parklands would be divided between both Councils.

* Liverpool and Fairfield Councils. A third Council, Bankstown, also bounds the river at the downstream extreme of the study area.

4.6 The Planning and Environment Commission
(State Planning Authority)

Recent legislation has abolished the State Planning Authority and placed rights and responsibilities of the S.P.A. in the hands of the Commission which is instructed to investigate the powers, responsibilities, authorities, duties and functions of the S.P.A. and the law relating to town and country planning, land use and environment planning and to prepare a report to the Minister within 12 months.

The Commission as such does not have clear authority to exercise all powers of the S.P.A. and is created to investigate the whole question of responsibilities in the field of town planning. Examination of those powers is a task best left to the Commission, but a few powers relevant to the subject matter can be considered briefly:

(1) to submit to the Minister proposals for the development and use of land and to carry out research and advise the Minister and Councils on matters relating to planning schemes (Section 12 State Planning Authority Act 1963);

(2) to enter contracts for the performance of service or supply of goods in connection with its duties (Section 13);

(3) to conduct investigations under the Act or the Local Government Act;

(4) to acquire or resume, dedicate lease or grant (Section 14) and engage in works on land (Sections 16-19);

(5) to create planning districts (Section 22) and appoint regional planning committees to make recommendations to the Authority (Section 24);

(6) to take over functions of the Cumberland County Council and Northumberland County Council (Section 26 and following);

(7) to exercise the functions outlined in Part XIIA of the Local Government Act as amended (Section 72).
The most important powers came under the last heading. They include the introduction, implementation and enforcement of town planning schemes.

For the purposes of this study it should be stated that the present zoning of lands within the subject area is predominantly Non Urban 'B', (a zoning which restricts sub-division to a minimum block size of 5 acres) and County Open Space. The area at present occupied by Hollywood Sands Pty. Limited on the north east bank of the river and land adjoining that to the north is zoned Non Urban 'C', (a zoning which fixes a minimum block area of 5 acres) and is to form part of the County Green Belt. A small section is zoned as Existing Recreation Area - that which forms part of the Hollywood Picnic Grounds. Nearby areas not within the subject area are zoned residential, and a large tract of land to the west surrounding Warwick Farm Racecourse is zoned as Existing Recreational. Most of the land is thus suitably zoned for conversion into parklands. S.P.A. zonings are subject to any existing planning schemes of Council (Sections 74 and 75 State Planning Authority Act) and an Interim Development order of Fairfield Council still applies north of the river.

Whilst its active role is not of great consequence, the power of the Planning and Environment Commission and advisor to the Minister and Supervisor of development in the area means that it has to be consulted and has to approve changes of use of land which depart from existing zoning.

4.7 Metropolitan Water Sewerage and Drainage Board

The Board has extensive powers with regard to waterways forming part of an area proclaimed by the Governor as being within the area of operations of the Board. The Board's operations are restricted to water supply sewerage and stormwater purposes (Section 31) and the Board is charged with the conservation, preservation and distribution of water for domestic and other uses.

Provided the Board has no plans for further activity in the area, its role in this project would appear to be peripheral except insofar as it conducts a treatment plant nearby. It is submitted that alleged excessive effluent from this treatment works polluting the river in the subject area is a matter for reference to the State Pollution Control Commission.

4.8 Maritime Services Board

The subject area is not within the Port of Sydney (see metes and bounds description in Schedule 4 of the Maritime services Act) and the Board therefore has powers only with regard to navigation as specified in the Navigation Act (in particular Section 7 thereof).
There are other powers of the Board set out principally in Section 12 and 38 (a) of the Maritime Services Act. These refer to the handling of cargo, control of moorings, pollution, development of ports, wharfs, control of the bed of port, use of ships, removal of derelict hulks, safety of explosives, the licensing of porters and the use of vehicles and machines on any wharf or Board property. The Board would thus have to be consulted in relation to any matter involving changes in the navigability of any inland stream and the establishment of any port facilities in or on the river.

4.9 Mines Department

The powers of all organisations and authorities herein reported on are subject to rights created under the Mining Act. This however, preserves from occupation all lands reserved dedicated, appropriated, resumed or acquired for public purposes or vested in trust for public purposes and land within any city, town or village outside a gold or mineral field and land covered by tidal water and within 100 feet of high water mark on the landward side (see Section 14 and Section 23 Mining Act).

The Governor has the power to exempt any lands from mining activities (see Section 14 (3), 23 (2) principally). Such rights as may exist in the area are abstracted in the Appendix.

4.10 Public Works Department

As stated previously, the Minister for Public Works has powers within the Rivers and Foreshores Improvement Act as a Constructing Authority.

All activities of the department are subject to the limits and restrictions of the Public Works Act. The works to be performed by the Department must be "authorised" within the meaning of the Act. The requirements for authorisation are contained in Part III of the Act and require the referring of certain matters to Parliament for approval. Alternatively the Legislature may approve certain public works and undertakings as defined in Section 41 of the Act for the purposes of (inter alia)

"(g) public wharves, ferries, piers, jetties and bridges;

"(h) public parks, or ground for public recreation, or places for bathing and for reclamation of land for or in connection therewith;

"(m) breakwaters, leading marks or beacons for the purposes of navigation, docks, ships, the protection of river banks,
the excavation of new channels, landing-places for silt, and any other works for improvement of harbours or rivers".

The Act provides comprehensive procedures for the acquisition and taking of lands where public works or authorised works are to be carried out. In particular the Act provides a complex system for the calculation of compensation for such resumption.

4.11 Summary of Existing Powers

(1) The various authorities considered herein each has some of the powers necessary to give effect to this project but no single authority has the necessary combination of resources and powers to control sand extraction and to build the desired lake amenity. It is clear that legislation is necessary to give coherence and purpose to solving the environmental problem which exists on the Georges River at Chipping-Norton and Lansvale.

(2) Whereas, the extracting firms have indicated a co-operative attitude towards bending their operations towards achieving a better end result they are adamant that this cannot be achieved unless they can deal with one, and only one, authority. It is also clear that such co-operation will be productive only if demands and controls are realistic as regards the extraction industry and are clearly necessary to the needs of the ultimate lake. This requires engineering expertise both to assess what is advantageous in developing the lake and what is reasonable to expect from the extraction operations.

(3) It appears that all authorities concerned with the area are agreed that a lake scheme is a logical and desirable end result. However, experience has shown that a uniform and co-ordinated approach cannot be achieved unless the various powers and objectives of these authorities be channelled through a single decision making authority. The function of such an authority would be to gather together the views of all interested authorities and to devise and implement the best overall plan of action. Within the specified area to be covered by the "Lake Scheme" the Authority recommended in this report should have overriding powers otherwise the situation may soon revert to what it is at present.

Legal opinion on the Rivers and Foreshores Improvement Act has thrown some doubt on the
powers of the Constructing Authority to authorise the removal of the river banks and/or to change the course of the river. Both events are fundamental to the Lake Scheme and consequently this Act should be clarified to ensure that the Constructing Authority has such powers.

The long term management of the completed lake and associated parklands does not seem to be a real problem at this time. It will be some 10 to 15 years before the work is completed and handed over to the Minister for Lands whose administration has long experience in the management of recreation areas and would be able to advise in plenty of time on any additional legislation which may be needed. Accordingly, it is considered that any legislation arising from this report should concern itself with immediate problems. That is, it should be aligned to the need to control sand extraction and the need to develop and build a recreation area out of the flooded borrow pits resulting from such extraction.

The Department of Public Works is the only organisation with the necessary engineering resources and expertise in river engineering which are essential to implement a lake scheme. The Minister for Public Works already has some responsibilities and powers apposite to the problem but these will need to be augmented as set out elsewhere. Once the work is completed it would seem appropriate that responsibility for long term management of the completed project become vested in the Minister for Lands.

4.12 Action Already Taken in the Area

Both the Liverpool City Council and the Fairfield Municipal Council have entered into agreements to allow sand mining in the subject area. This activity would appear to be a valid use within the zoning regulations if approved by the Minister or established as an existing use. The agreements allow for payment of royalties to the Councils. Councils may also insist on compensation for any injurious effects of these activities on Council lands and roads. (See notes on Council powers). As outlined in the Interdepartmental Committee Report (page 5) damage has been done to the river bank in several places in contravention of the Rivers and Foreshores Improvement Act. All other aspects of land use are related to the powers of a landowner with regard to his land (see page 6 Interdepartmental report).
Powers Required

The authority entrusted with the construction of the lakes should have at least the following powers within its area of jurisdiction:

(1) Power to acquire any land by purchase or resumption.

(2) Power to determine the amount of compensation, if any, payable to those whose land is resumed.

(3) Power to resume and to close any public road and to determine compensation, if any, payable to Council.

(4) Power to resume any land set aside for public use which is not already vested in the Crown and to determine compensation, if any, payable.

(5) Power to require the removal and/or relocation of services and to determine compensation, if any, payable.

(6) Power to lease or otherwise dispose of land which may become vested in the "Authority" on such terms as it sees fit.

(7) Power to control all aspects of sand extraction.

(8) Power to take over from Council any existing agreements concerning extraction of materials and to determine compensation, if any, payable to Council.

(9) Power to authorise the extraction of material from any land on such terms and conditions as it sees fit.

(10) Power to revoke any "Existing use" rights to extraction brought forward from the time when town planning controls did not apply.

(11) Power to cancel or vary any permit or consent to extract materials should the conditions of such permit or consent not be met or should there be grounds to believe that extraction or restoration work will not be completed in a reasonable time.

(12) Authority to receive moneys from any source and to apply same to the purposes of the scheme. This would extend to works considered necessary to the scheme but lying outside the formal boundary of the lake area.

(13) The authority to prepare a detailed scheme for development of the area for approval by appropriate planning and environment authorities.

(14) Authority to carry out all works pertinent to implementing the scheme.
4.14 Commentary on Powers Outlined

(i) Powers (1) to (6) inclusive deal with land matters. It is considered essential that all land necessary for the ultimate lake recreation facility should be consolidated under a single ownership. This will ensure:

(a) A full and proper programme of sand extraction.

(b) An overall integrated plan for the future use and development of the area.

(c) A unified and consistent control of the area during all phases of extraction, construction and eventually operation and management.

There will be roads and services made redundant by the extraction which should be incorporated in the lake.

(ii) Powers (7) to (11) inclusive deal with the control of extraction. In effect all current consent deeds or arrangements would be transferred from Council (as a principal) to the lake authority with due consideration to any arrangements for the maintenance of roads. The report by SL & M indicates that all such agreements contain a time limit, however, it is considered necessary to be able to exert pressure, if needed, to ensure that extraction proceeds at a rate commensurate with such time limits. The same source indicates that there are no longer any "Existing Use Rights" in the area but it is felt prudent to cover such a contingency to ensure that all extraction within the area will be completed in a reasonable time.

(iii) Power (12) deals with financing of the scheme. It is suggested that a Special Working Account be set up to consolidate and unify accounting for the income and expenditure involved in the project. This would also provide flexibility as to funding expenditure on works from revenue or loan sources.

(iv) Powers (13) & (14) are provided to authorise expenditure on the planning and construction of the project.

4.15 Example - National Parks and Wildlife Service

The powers and functions outlined in Section 6 of the National Parks and Wildlife Act 1967 are of the type that could be included in any legislation creating the proposed authority. The regulation powers in that act (in Section 49) and the finance powers in Part V would also be of use in this particular case. The act would have more general
relevance to this project were it deemed necessary or desirable to make the Authority a permanent organisation charged with the administration of all such schemes.

4.16 Agreements

It is submitted that for the purposes of this project a standard form of agreement should be devised that the Authority and the various mining companies should enter. The form adopted by the Fairfield Council with appropriate amendments seems a satisfactory starting point for this purpose. However, the Authority should also have the power to determine an agreement when satisfactory progress has not been made.

4.17 Advantages of Independent Authority

(1) The creation of such an authority would obviate the need for multiple agreements between various authorities and prevent anomalies between these authorities due to their overlapping powers.

(2) The vesting of land in one Authority would prevent problems arising over title to the land, and the responsibility to prepare schemes for approval by the Planning and Environment Commission would obviate the difficulties noted in 4.5 hereof.

(3) The creation of the Authority would simplify correction of possible breaches of various acts and prevent ultra vires activities by landowners and authorities in the area, particularly in view of the fact that extensive damage has already been done to the foreshores.

(4) A single authority would ensure that sources of funds implicit in the scheme were fully explored so as to limit demands on general public funds. It would also ensure that such funds were allocated to best satisfy needs and that they would be consolidated and accounted for on a project basis. In the allocation of such funds the Authority would need to have regard to existing arrangements between Councils and the extractive industry.

4.18 Choice of Authority and Practical Considerations

The timetable for lake development falls into three main categories: -

1. Urgent control and co-ordination of the current mining activities.
2. Detailed planning and engineering works on the lake and foreshore lands including land acquisition, environmental and landscaping factors.

3. Management and development of the lake and foreshore lands as an operating public amenity.

These categories are expanded in Section 7, but for consideration of the form the "Authority" should take, the following comments are relevant in this section:

Comment on 1: Control and co-ordination is now urgent and should anticipate the legislation to create the Authority. The role of the body exercising this interim control is primarily one requiring an understanding of bank stability, river hydraulics, wave action and engineering administration, i.e. essentially the role of a Constructing Authority. The body should also be impartial as to the affected councils, and owners or operators. With reference to Sections 4.2 and 4.10 of this report, the Public Works Department is the only independent authority with some existing powers and the engineering knowledge for the task.

Comment on 2 and 3: In considering the composition or choice of the Lake Authority it is pointed out that:

(i) The functions of 2 and 3 are somewhat different; the former requires an engineering and planning function over a relatively few years while the other will involve legal administration and park management on a long-term basis.

(ii) The specialist knowledge and experience necessary for functions 1 and 2 is not freely available and to set up a special authority may present difficulties in obtaining suitable personnel on a short-term basis. This problem would be minimised if the Public Works Department were to carry out the Category 1 function through to the end of Category 2.

(iii) Permanent management of the lake could be by a special "Authority" but the proliferation of governing authorities each with its own overhead burdens etc. is not desirable in itself, if in fact an existing body has the necessary experience and capacity to deal with the task. It is thus suggested that the Department of Lands could fulfil the park management function, taking over from the Public Works Department once the engineering planning and development phase is fulfilled.
4.19 Mechanism for Lake Development

To summarise, the legal and practical aspects of the lake development required and recommended are:

(a) The necessary legislation should be enacted along the lines described to permit a single authority to co-ordinate the lake development.

(b) That to avoid the difficult and unnecessarily expensive task of setting up a special engineering authority on a short-term basis, the Minister for Public Works would become the initial "Lake Authority".

(c) That, upon completion of the lake scheme the "Lake Authority" transfer the area to the Minister for Lands for continuing management and development. This could be done progressively as sections are completed.

The legislation would therefore be drafted in such a way that the Minister for Public Works became the Lake Authority initially, and a special fund would be set up to receive funds, purchase land and so forth. On a portion by portion basis, ownership of completed sections of the lake and foreshores would be transferred to the ownership and control of the Minister for Lands. Upon completion of the Lake Scheme the trust fund would be wound up.

4.20 Chipping-Norton Authority

Although it is recommended that the work be done by an existing Authority it is also suggested that a local identity be given to the project. The name "Chipping Norton Lake Authority" is suggested.

The "Area of Responsibility" of the Authority would be as defined by the Governor in Council from time to time. The suggested physical boundary of the lake and associated foreshore areas is shown on Figure 11. The 50 metre wide restricted development zone is required to control future development and to ensure access to cover any need for bank protection works. It does not imply any alteration to existing uses.

In so far as upstream or downstream engineering works may be necessary on hydraulic considerations, the area of responsibility should extend beyond the lake proper. On this basis it would then be proper for the Chipping Norton Authority to expend monies from its funds on works outside the gazetted area.

Upstream of the proposed lake there are other sand extraction areas that could be incorporated within the scope of the Authority as a chain of lakes. The legislation could allow for this possibility.
1. Suggested final islands left for recreation or sanctuary purposes and to reduce wave fetches and protect banks.
2. Recreation or open space boundary, lake shore.
3. Original lake boundary.
4. Proposed actual lake shoreline to take account of existing erosion and to improve landscaping.
5. Boundary of Chippins Norton Authority.
6. Restricted development zone 50m from lake.

SUGGESTED FINAL ISLANDS LEFT FOR RECREATION OR SANCTUARY PURPOSES AND TO REDUCE WAVE FETCHES AND PROTECT BANKS.

RECREATION OR OPEN SPACE BOUNDING LAKE SHORE.

ORIGINAL LAKE BOUNDARY.

PROPOSED ACTUAL LAKE SHORELINE TO TAKE ACCOUNT OF EXISTING EROSION AND TO IMPROVE LANDSCAPING.

BOUNDARY OF CHIPPINS NORTON AUTHORITY.

RESTRICTED DEVELOPMENT ZONE 50M FROM LAKE.

PROPOSED BOUNDARIES OF LAKE FORESHORES

FIGURE 11
5.0 LAND OWNERSHIP AND COMPANY ATTITUDES

5.1 Land Ownership

As outlined in the previous section, titles are in four categories: - the river bed vested in the Crown; public reserves; "the two chain strip" vested in the freeholder but with some control in the hands of the Constructing Authority; freehold land bordering on the river. In addition to this, the roads in the area are vested in the Councils.

Figure 12 shows the property boundaries and ownership of lands affected by the proposed lake and foreshore areas. With the exception of the established residential area behind the high northerly bank; most of this bank is already bordered by reserves or open space zoning as shown. This means that the proposed lake and foreshores will involve practically no changes to the existing zoning in the Liverpool and Fairfield Planning Ordinance Scheme.

It is also interesting to note that the Mining Search disclosed a petroleum exploration license for the area.

The legal mechanisms for obtaining control of the land to be vested in the lake scheme were discussed in Section 4. Apart from roads or public land the affected land is estate in "fee simple" and no significant problems would be expected in any future transfers relating to the scheme.

The question of existing usage rights which, as discussed in Section 3, gave rise to problems of control in the early stages of extraction, is no longer a problem as these areas have either been mined out or sold or leased to the major extraction companies who are operating under the Council agreements. However, it would be prudent to provide in the legislation for dealing with any possible difficulties in this regard.

5.2 Company Attitudes and Royalties

In the Soros Longworth & McKenzie report, the consultants interviewed the extracting companies. Their findings were that after some initial reluctance to become involved in 'yet another study', the companies have proved co-operative, if not completely open-handed, about supplying information for this investigation.

In so far as formation of the lake is concerned, the companies are prepared to co-operate to any reasonable extent, bearing in mind that under the present agreements with Councils, and subject as they are to the various, and often conflicting
requirements and interests of many statutory bodies, there is little room or opportunity for them to evidence their willingness to co-operate without prejudicing the viability of their operations. They also consider rightly or wrongly that they are subject to unduly high local rates, and that this should be borne in mind when discussing their "contribution" to the lake scheme.

The three large public companies controlling the land at Chipping-Norton are committed to the extractive industry and are well aware that their viability over the years will depend to a large extent on their ability and willingness to conduct their operations here and elsewhere in an environmentally acceptable manner. The same applies to a somewhat lesser extent to Hollywood Sands and other possible operators. However they are also conscious of the fact that as conditions are at the moment, unreasonable demands by any authority, made outside their present rights and agreements, can be ignored to a large degree.

They look forward to the day when they know in advance what restrictions are to be placed on their operations and they can plan and budget for the life of the operation. Thus they are of one accord in offering co-operation with a unified "Lakes Authority" which presumably would have established goals and would regulate their operations in an even-handed manner. It is considered that the companies may be prepared to discuss entering new agreements with such an authority.

Royalties

The potential sand reserves contained in river bank reserves, in road easements and barriers, and in the river itself, can provide a "Lakes Authority" with a source of finance, and at the same time are an inducement for the companies to co-operate with the "authority" in forming the lake in an orderly sequence. The release of these reserves to the companies can extend their life by many years and such release is recommended.

It is understood that the companies could be prepared to pay a royalty to an "authority" for sand extracted from frozen reserves. This royalty could be used to finance the "authority" and/or works associated with the formation of the lake. Forty cents (40¢) per tonne recovered for sale has been suggested by the SL & M report as a reasonable figure for such a royalty, with provision for adjustment by negotiation in regard to operations carried out solely for the benefit of the lake scheme.
For example, it may be necessary for certain areas to be dredged in an area remote from a sand plant, or for the sand in a certain area to be dredged and placed for the formation of a beach. In these instances there is room for a "quid pro quo" type of royalty agreement being reached with the companies.

Some provision for the effects of inflation should be worked out in any agreements regarding royalties or taxes on the remaining reserves.

A royalty of 40¢ per tonne sold would return some $2 million from the reserves estimated as being recoverable from the area, but which are at present frozen by various agreements and statutory requirements. It would seem that the greater part of these royalties can be applied directly to the formation and maintenance of the lake and its foreshore amenities. Finance for the lake authority may need to be advanced against future royalties, in the event that extraction of the frozen reserves is not commenced for some time.

5.3 Specific Points Raised by the Operators

MONIER:

The company has a large investment in the washing plant which is considerably more elaborate than most plants producing sand for the construction industry. The plant is fed with dry or damp sand, which may be blended to ensure a relatively constant quality of feed. Washing, separation and sizing operations are carried out in a series of hydraulic classifiers and Remer jigs whose operating characteristics can be varied to accommodate variations in feed quality, and also to produce different sized products from feed of the same quality. Washed sand from the jigs is dewatered in a centrifuge, and then stockpiled via a radial stacker conveyor.

The currently mineable reserves available to the company will be exhausted before the 1983 expiry date of their agreement with Liverpool Council. However, the company is not prepared to commit itself to vacate the site before this date, since their plant is sufficiently versatile to handle almost any quality of raw feed sand, they wish to retain the option of treating imported sands at the site at least until such time as their agreement expires.

RIVERVIEW SANDS: (FARLEY & LEWERS)

This company draws its raw feed from three suction cutter dredges. Sand slurry from these dredges is pumped via floating lines to shorelines along Epsom Road. At a point some 250 m from the washing plant these shorelines discharge back into the pond to form an underwater stockpile, from which a fourth dredge retrieves the now readily dredgeable sand and delivers
slurry via a floating line to the shore based
washing plant. The most remote dredge is now
pumping sand about 400 m to the staging dredge
and this is considered to be the economic limit
for pumps of the size fitted to the dredges.

The company is understood to be actively discussing
the removal of Epsom Road and its easements with
Liverpool Council, prior to making a decision as to
when they will pull back their washing plant from
the peninsular in order to shorten up the delivery
lines.

LIVERPOOL COUNCIL

Liverpool Council, which has a vested interest in
the formation of the lake, consume quantities of
filling sand and topsoil within the municipality.
The Council owns a dredge suitable for working some
of the area, and it is understood that they would
consider any proposition from a "Lakes Authority"
to work some of the currently frozen areas, even if
these areas were economically unattractive to the
commercial operators.

BLUE METAL INDUSTRIES LTD. (B.M.I.)

This company owns Portions 345 and 353 Lot 1, but
is not operating in the study area. Monier Sands
are extracting material from Portion 345 under a
royalty agreement with B.M.I. and are understood
to be negotiating an agreement regarding Portion
353 Lot 1. In view of these negotiations and to
simplify calculations, the reserves on this
portion have been attributed to Monier.

The company has expressed its willingness to co-
operate with plans for formation of the lake,
bearing in mind however that its holding in the
area is relatively small and it is not operating
on the land.

In regard to royalties from these areas it should
be borne in mind that some of the land is currently
being worked under royalty agreements with the actual
landowners. In the event of these reserves being
released for extraction, the companies would not be
prepared to pay double-royalties, that is, one to
the owner of the land, and a second to the "authority"
for having released the land for extraction. Under
these circumstances it may be necessary for the
"authority" to resume certain land from the title
holder, before releasing it for extraction to the
operating companies.
In short, the operating companies and, it appears most other parties interested in the area, would be willing to co-operate if given the firm lead of a "Lakes Authority" type of body. However they make the point that it should be ONE authority and not a committee attempting to co-ordinate a number of regulatory bodies.

AERIAL VIEW OF PRINCIPAL SAND PLANTS

Photographs, figures 13, 14 and 15 show respectively the operations of: -

RIVERRVIEW SANDS
MONIER
HOLLYWOOD SANDS
FIGURE 13 - MINING OPERATIONS - RIVERVIEW SANDS
6.0 RESERVES AND FUTURE EXTRACTION

6.1 Depth of Sand and Limits

The Soros Longworth & McKenzie report examined the logs of eighty-five exploratory drill holes sunk at various locations within the boundaries of the proposed lake, to determine sand reserves in the area. Four of these holes were drilled by the P.W.D. and the others were drilled by various companies or by reputable drilling contractors acting for companies engaged in the Extractive Industries.

Figure No. 16 summarises the sand shale depth information in histogram form. This indicates only a remote possibility of economic sand deposits existing at depths greater than 18 m (60 ft.) below water level since the deepest shale basement recorded to date has been at RL 16.75 m (55 ft.)

The average level of economic sand calculated from drill information is RL 8 m (26 ft.) The histograms indicate however that a significant number of holes have proved economic sand to RL 12 m (40 ft.) In areas where washing tests have been made on drill samples, the economic limit for this study was set at depths where the washing loss exceeded 20% by weight. If a 30% weight loss could be economically countenanced, then the limit could in some areas be extended by about another 2-3 m (5-10 ft.)

At the present time the companies subject to agreements with Liverpool Council are restricted to a depth of 7.6 m (25 ft.) below water level, and those subject to agreements with Fairfield Council are restricted to a depth of 12.2 m (40 ft.) below water level.

The deepest economic sand limit encountered has been at RL 14.6 m (48 ft.) and the deepest shale basement has been at RL 16.75 m (55 ft.) Thus these limits whilst reasonable in some areas, significantly restrict the reserves available in other areas.

The reserves tabulated have been calculated to what is considered the bottom of the economically viable sand. No detailed calculation of the potential loss of recoverable sand caused by the imposed depth limitations has been made. However, rough estimates indicate that of the order of 750,000 tonnes of saleable product could be frozen by these limitations.

If needs be that a limit be set to dredging depth, RL 17 m (55 ft.) would ensure that virtually all the recoverable sand is made available for extraction without the necessity of defining what is economically viable for the operators.
HISTOGRAMS OF SAND/SHALE DEPTHS FROM BORE HOLES.
IN CHIPPING NORTON AREA.

Number of boreholes: 85
Shallowest: R.L. - 4 ft.
Average: R.L. - 20 ft.

Number of boreholes: 55
Average: R.L. - 35 ft.

FIGURE 16
KEY & NOTES

1. -- ORIGINAL LAKE BOUNDARY.
2. -- SUGGESTED ACTUAL LAKE SHORELINE TO TAKE ACCOUNT OF EXISTING EXCAVATION AND TO IMPROVE LANDSCAPING.
3. -- AREAS WITHIN WHICH TOTAL RESERVES CALCULATED.
4. -- BOUNDARY OF CHIPPING NORTON AUTHORITY.
5. -- RECREATION OR OPEN SPACE BOUNDING LAKE

FIGURE 17
To ensure relatively uniform extraction over the area, some consideration should be given to the experience of the operators and the capabilities of the equipment they propose using. For example, small suction dredges or low powered suction-cutter dredges could be expected to work only the loose sands and would leave underwater mounds or ridges capped by cemented sand or stiff clay lenses which could be extracted by more powerful equipment.

6.2 Reserves

The reserves summarised in Table No.1 have been calculated within the area defined on Figure 17. This is an area bounded generally by the Georges River and the limits of the proposed lake and occupies an area of approximately 140 hectares.

In some areas the calculated resources extend outside the limits of the proposed lake. Specifically these are:

(a) areas owned by or being mined under licence by sand mining companies, and adjoining extracted areas or are themselves partially extracted;

(b) the three blocks owned by the Planning and Environment Commission two of which have been partially extracted.

Tonnages have been calculated for these areas, since they are of concern to the owners/operators in regard to their future operations and the proposed lake scheme.

The total tonnage of saleable product estimated as being contained within the defined area is 13.5 million tonnes, of which only 6.0 million tonnes are presently recoverable under existing conditions.

In order to form the lake as outlined in the Munro report, various roads and easements must be excavated along with the statutory 2 chain river bank reservations.

Together with sand estimated as recoverable from the bed of the river and upstream of Portion 339 (see Figure 12) these areas represent potentially recoverable reserves of 5.1 million tonnes, making the total recoverable and saleable product 11.1 million tonnes.

Minor variations of the shore-line as proposed in this report to accommodate excavation already existing outside the "Munro-line" do not significantly alter the calculations.

The inclusion of islands in the lake as shown on the drawings causes a reduction of recoverable material, amounting to an estimated 1.8 million tonnes. The potential loss appears larger than the islands would seem to necessitate, due to the underwater batters
<table>
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<td></td>
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<td></td>
<td></td>
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<td>metres</td>
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<td>3.9</td>
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<td>Epsom Road</td>
<td>-</td>
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<td>0.1</td>
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<td>Upstream fairing</td>
<td>-</td>
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<tr>
<td>P.E.C. Blocks</td>
<td>-</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>TOTAL CONTAINED IN AREA (see Figure 17)</td>
<td>0.6</td>
<td>8.9</td>
<td>9.5</td>
</tr>
</tbody>
</table>

Recoverable with Present restrictions except depth
- Recoverable to Munro line
- Recoverable to Irregular Shoreline (a) no islands
  (b) islands as shown

...
retained around the island. The lake shore protection and beautification afforded by the islands should be offset against this loss of reserves in the final economic and environmental balance.

The 1.2-1.5 million m$^3$ of waste material discarded from the production of saleable material is composed of the silt and clay fractions of the deposit, together with some iron cemented sand nodules, lateritic stones, and organic matter such as charcoal and decomposed wood. Dispersed over the 140 ha. it represents a depth of about 0.80 m. or built up as a foreshore extension it represents an area of about 9 hectares.

The tonnage designated as MINEABLE are those reserves which are mineable subject to all presently imposed restrictions except depth limitations.

The limit of depth of extraction has been considered to be the depth at which washing losses exceed 20% by weight, or alternatively the drill log interface of sand with clay, shale, sandy clay or silty clay.

River bank reserves are the reserves retained in the 2 chain reservation and its 1 in 3 pond-side batter. Soundings taken between remnants of the reserve indicate that the underwater portions have been almost entirely eroded away. Consequently no reserves have been estimated for any underwater remnants. Where the reserve is less than 2 chains in width 1 in 3 batters have been allowed from the existing shoreline. No batter has been allowed for on the river side.

Tonnages designated as River Bed Reserves, are reserves considered recoverable between the deepest line of the river and a vertical plane extending from the river bank to the depth of "economic sand". In no case is the batter created by this excavation steeper than 1 in 3 or steeper than the existing underwater banks of the river.

The tonnages specified as Road Easements and Property Barriers are those included in the various 20 ft., 50 ft., and 100 ft., easements and barriers together with the 1 in 3 batters required by the different authorities regulating operations.

In the area upstream of Portion 339, and on the point opposite Prospect Creek, the 1 in 3 batter has been assumed to commence at the proposed shoreline and no allowance has been made for material that might be retained to provide shoreline parks, access, or property barriers.

Epsom Road reserves are the reserves contained beneath Epsom Road from the corner of Charlton Avenue north to the 2 chain river bank reserve. The reserves calculated for the Right Bank Fairing upstream of Portion 339, allow for a 1 in 3 batter from the lake shore and include what would normally be the 2 chain river bank reservation.
6.3 Waste

Processing of the raw sand is basically a screening and washing process which is controlled to reject undesirable organic matter and fine fractions from the principal product. Thus during the initial screening processes, clay lumps, nodules of cemented sand, decomposed wood from ancient flood debris and root matter are rejected. During washing, silt, clay particles and charcoal are separated out by various methods of classification which include settling, jigging, film concentrating and cycloning.

Monier

Coarse waste rejected from the dry grizzly and wet screen is retained and used to restore the final batters in ponds which have been completed. Whilst these batters may have been completed in accordance with council requirements, natural run-off and frequent overtopping during flooding of the river causes erosion of these batters.

Fine materials rejected during the washing process passes to the large settling pond on Portion 340. Process water for the washing plant is drawn from the substantially clarified water in this pond. Excess water in the settling pond overflows into the western pond on Portion 339, which is open to the river through a narrow channel cut through the 2 chain reservation.

The coarser reject material is recovered from the settling pond as it accumulates and is sold as filling sand.

Riverview Sands Pty. Ltd. (Farley & Lewers)

Depending on quality coarse reject is either used for restoration of banks around the "island" on which the plant is currently situated, or is sold as filling material.

Fine reject from the washing process passes to a series of small settling ponds from which the overflow discharges into the "pond" on Portion 350 at the south-east corner of the island. The coarser fraction of this material settles out in the first of the ponds and is recovered for sale as filling sand. Several other ponds in the series are infrequently cleaned and appear largely ineffective. Consequently there is significant accumulation of silt in the "pond" on Portion 350, which has probably been accentuated by the enforced re-instatement of some 80-100 m. of river bank, since the re-building of the bank has created a back water with improved settling conditions.

The material used to restore this 80 m. of river bank is considered to be of poor filling sand quality, so that in the event that Epsom Road and the "island" are extracted there would remain a large "shoal" of sand and silt. Conceivably the silt would eventually be dispersed by water movement, however the sand "shoal"
would remain below the level of wave action.

In this regard the suggested island would afford a foundation from which to fill out over the sand shoal with material dredged from the river bed or adjoining island remnants of the 2 chain reserve.

Hollywood Sands

Both coarse and fine reject from the combined dredge treatment plant is discharged to the virtually closed pond at the stern of the dredge. This settles and is accumulating on the floor of the pond.

This method is acceptable whilst the dredge is operating in a closed pond except that the waste will have to be reworked to recover sand from greater depths in the event that the present depth restrictions are lifted.

If the dredge is operating in open water it is possible that the discoloration of the water created by the cutter and the open discharge of waste may prove unacceptable.

A suggestion has been made that dredging to steeper batters should be permitted along the final shoreline and that the settled waste could be used to restore the required 1 in 3 batters by drag-lining from the floor of the pond. This suggestion would require careful consideration before acceptance.

The design of 1 in 3 batters was based on the properties of the in-situ raw sand, and it seems likely that an angle flatter than 1 in 3 would be necessary to ensure stability of the natural bank if the batters are to be constructed from unconsolidated waste. Furthermore it is conceivable that the amount of waste required to construct a stable batter would be more than could be reached by a drag-line operating from the shore.

In order to accomplish creation of the lake as outlined in the Munro report, the river bank reserve and the council land at the eastern end must be extracted. From a dredging viewpoint it would be more acceptable to work the 2 chain reserve and the "mineable" area concurrently with the river bed from one or other end of the property, rather than for a dredge to work the pond first and then have to work the 2 chain reservation and/or the river bed in isolation.

Dredging the "full face" would involve working in open water, as opposed to a closed pond as at present. Under these conditions it could be that the open discharge of waste as currently practiced by the company may create unacceptable discoloration of the stream, as well as making utilization of the waste for batter or island formation both difficult and expensive. Consideration should therefore be given to discharging waste from this dredge by a floating line, for deposition along the final shoreline. If provision is made for draining the
POSSIBLE USE OF WASTE FOR BEACH CONSTRUCTION.
waste discharged, it could conceivably be used to fill low-lying flood-prone land in the immediate vicinity of the property.

The question of waste disposal requires urgent consideration and planning in conjunction with the operating companies if its potential for beneficial utilisation is to be realised in the creation of the lake. If this is not done the Monier Operation and the shortly to be re-located Riverview Sand plant will eventually create further "silt-shoals" which could create either minor hazards to boating on the lake, or unnecessary dispersion of silt over the lake floor and the river bed.

Experience with similar slime material has shown that if confined laterally it can be "filled-over", sufficient for the needs of parkland and foreshore amenity areas. In return for access to alternative sand resources in the 2 chain reservation etc., it is believed that the operators would willingly retain or create ponds with stable banks of retained in-situ material sufficient to accommodate most, if not all of the tailings from present and future operations.

The waste material could also be used for building up sub-layers to beaches where bank protection was necessary, or a beach desirable; see Figure 18.

Clay banks occur on Portions 343 and 342, and there are indications that they may occur under Portions 339 and 340 also. It is unlikely that these under water "highs" will cause any loss of amenity to the area, however the point is made that if direction can be given to the companies in sufficient time, highs such as these could likely be filled over with waste material to form islands at no great expense either to the company, or to a "lakes authority". To be aware of these possibilities requires frequent liaison with the companies, and should be the responsibility of one authority.

6.4 Value of Reserves

Three saleable products result from the sand mining operations. Washed sand, is clean sand free from clays, organic matter and soil. The finer grades are acceptable for mortar and for blending with coarser sand from other areas to produce a concrete sand. A medium grade sand is supplied direct to ready-mix concrete plants. Filling sand, or filling varies in quality depending upon the use to which it is to be put. The better quality is coarse material separated out either during the washing process or which has settled out and is recovered from the settling ponds. If the reject material from the earlier screening operations is sufficiently free from clay and organic trash it may be set aside and sold for large scale filling operations. The Top Soil is a sandy loam of varying depth, and is stripped off before dredging commences.
The present selling prices for material produced in the area are:

Washed Sands $3.30 - $3.60 per tonne ex yard
Filling Sands $1.85 - $2.90
Top Soil $2.40 - $2.90

The proportion of washed sand to filling sand produced varies according to the quality of the raw feed, but commonly it represents 60-70% of the raw feed. Assuming an average of 65% the average selling price for the sands fraction of sales would approximate to $3.25 per tonne ex yard.

The companies have not been willing to disclose their operating costs. However, estimates based on a knowledge of their operations indicate production costs in excess of $2.00 per tonne before head office costs, insurance, land tax, rates, interest charges, etc. and before tax. Nett profit after tax is thought to be in the vicinity of 40-60% per tonne of total sales.

Assuming an average selling price of $3.25 per tonne for washed sands, $2.50 per tonne for top soil, and a nett profit of 50¢ per tonne, the gross value and nett profit content of the reserves tabulated would be:

<table>
<thead>
<tr>
<th>Estimated Gross Value $ x 10^6</th>
<th>Estimated Nett Profit $ x 10^6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mineable</td>
<td>18.8</td>
</tr>
<tr>
<td>River Bank</td>
<td>10.4</td>
</tr>
<tr>
<td>River Bed</td>
<td>2.5</td>
</tr>
<tr>
<td>Epsom Road</td>
<td>0.7</td>
</tr>
<tr>
<td>Easements</td>
<td>7.1</td>
</tr>
<tr>
<td>Upstream</td>
<td>2.0</td>
</tr>
<tr>
<td>S.P.A.</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>42.0</td>
</tr>
</tbody>
</table>

Recoverable under present restrictions 18.8 3.0
Recoverable to Munro line 34.8 5.5
Recoverable to irregular line no islands 34.7 5.4
with islands 28.7 4.5
6.5 Additional Reserves in the Vicinity of the Study Area

Sand mining is currently in progress in the area immediately downstream of the Liverpool Bridge and which is upstream of the study area. Significant quantities of sand are being taken from the area and it is evident that a second, though much smaller, 'lake' is in the course of construction and should necessarily be the concern of a 'lakes authority', if it were to be also developed as a lake.

Sand is known to exist on D.P.'s 2411 and 29887 at the northern end of Riverside Road, Chipping-Norton and in the low lying ground lying north and south of the unmade section of Arthur Street, Moorebank. This low lying ground probably constitutes what was, or is, a flood channel by-passing the Milperra Bridge bend, and has been suggested as the route for a possible flood diversion channel to relieve problems in the narrow reach above and below the bridge.

Good sand is believed to exist on Pt. Por.24 and D.P. 2411 upstream of the Monier operations and this has been taken into consideration when estimating reserves.

Some sand is known to exist on the triangular block of land titled Section K between Hollywood Drive and Howard Street, Lansvale, though there is also believed to be a significant amount of clay present.

In other areas information is sketchy and certainly no reliable estimates of potential reserves can be attempted.

In view of the diminishing reserves of construction sand in the inner metropolitan area, it should be of concern to the 'Lakes Authority' to seriously consider the merits of permitting the extraction of any future discoveries of sand in the area adjoining the lake as presently proposed.

6.6 Condition on Completion

The companies operating in Liverpool Municipality are bound by agreements with Council in regard to operating conditions. The agreement specified depths of extraction, road easements and batters which cannot be extracted by the operator, and requires the operator or owner to leave the land in a "clean and tidy" condition before dedicating the land free of cost to the Council on, or before, expiry of the agreement depending on whether or not excavation has been completed. It is understood that Liverpool Council has had a new form of agreement prepared for future operations, and which is somewhat more stringent in its requirements.

The agreement made between Hollywood Sands and the Fairfield Council is more demanding on the company in regard to the condition in which the area is to be left on completion of extraction. In addition to royalty and
rent payments, the company is required to submit a landscape plan to Council for each lot of 10 acres on which extraction has been completed, and to landscape the said foreshore in accordance with Council's approval.

These conditions are not such as to rapidly advance to completion of the lake in its final form, since even the conditions agreed to by Hollywood Sands would be unreasonable if enforced while the possibility of extracting the river bank reservation remains unresolved. Several boundaries of the proposed lake have been left in a "clean and tidy" condition. Elsewhere extraction has not been completed to the boundaries of the lake, and whilst the amount of rubbish and debris to be removed to leave them in a "clean" condition pursuant to current agreements is minimal, it seems unreasonable to enforce the "tidy" requirement until such time as the question is resolved as to, by whom and when the "frozen reserves" are to be extracted.

In agreeing to release "frozen reserves" to the companies for extraction, a 'Lakes Authority' could require the companies to comply with restoration requirements more appropriate for the foreshores concerned in a particular area.

6.7 Completion Dates

It is not possible to give accurate predictions for the date of completion of any particular plot, since the quality of sand and digging conditions encountered are too variable for the operators to detail their sequence of extraction for more than a few weeks or even days ahead. Coarse sand encountered when demand is for a fine sand may necessitate the shifting of a dredge or excavators from one location to another to accommodate the immediate market needs. Similarly clay banks and lenses, and particularly heavy depositions of silt, or decomposed timber in an area, can force the operator to move to another location until he can afford time to return and clear the obstructions.

This method of operation is forced on the sand miner by the nature of the deposit, and is typical of the conditions encountered in flood plain sedimentary deposits of this kind. It is also almost solely responsible for the "scarred and pot-holed" appearance of the areas which have not yet been completely mined out. To the extent that Monier and Riverview Sands now control the mining in the Chipping-Norton area and have the capacity to draw sand from different areas of their holdings, their operations must be considered to be more efficient in terms of operating efficiency and recovery of sand reserves than would be the small operator working within a small holding.
Estimates for the date of completion for small areas are also complicated by the necessity to leave barriers between plots during dry mining. Some areas exist which are mined out except for barriers which will be cleaned up by dredging once the dry mining sequence is complete.

Subject to present agreements and restrictions, the following portions have been completed:

- Portion 393
- Portion 392
- Portion 351
- Portion 347
- Portion 348

Minor amounts, that is less than 100,000 tonnes, remain to be excavated from the following portions:

- Portion 353 Lot 2
- Portion 353 Lot 3
- Portion S.P.A.
- Portion 452
- Portion 342
- Portion 343
- Portion 341
- Portion 349-350-394

Dry mining on Portion 342 will be completed in the very near future and the portion will be flooded to enable dredging of the remaining material to be completed.

The estimate of dates of completion of operations are based on the following assumptions:

(i) Monier Sands to sell 300,000 tonnes per annum and that the reserves in the area of the plant are not excavated before 1983 or final year of operation if a later cessation of local mining becomes possible. Mineable reserves are assumed to include Norton Avenue, the un-named road their easements and batters.

(ii) Riverview Sands to sell 200,000 tonnes per annum and likewise to excavate the sand beneath the plant site during the final year.

(iii) Hollywood Sands to sell 300,000 tonnes per annum, and take up any shortfall from the other plants, up to a maximum production rate of 600,000 tonnes per annum.

(iv) No allowance is made for production from the peninsular opposite Prospect Creek.
(v) That the sale of top soil is not a factor in determining the life of sand mining operations.

(iv) That reserves do not include material contained in the Planning and Environment Commission Lots.

A. RESERVES AS CURRENTLY AVAILABLE

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monier</td>
<td>1979</td>
</tr>
<tr>
<td>Riverview</td>
<td>1981</td>
</tr>
<tr>
<td>Hollywood</td>
<td>1981</td>
</tr>
</tbody>
</table>

B. AS ABOVE PLUS ROADS AND EASEMENTS

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monier</td>
<td>1980</td>
</tr>
<tr>
<td>Riverview</td>
<td>1984</td>
</tr>
<tr>
<td>Hollywood</td>
<td>1981</td>
</tr>
</tbody>
</table>

C. AS ABOVE PLUS RIVER AND BANKS

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monier</td>
<td>1986</td>
</tr>
<tr>
<td>Riverview</td>
<td>1988</td>
</tr>
<tr>
<td>Hollywood</td>
<td>1988</td>
</tr>
</tbody>
</table>

D. AS ABOVE PLUS UPSTREAM FAIRING AND RIVER

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monier</td>
<td>1990</td>
</tr>
<tr>
<td>Riverview</td>
<td>1988</td>
</tr>
<tr>
<td>Hollywood</td>
<td>1989</td>
</tr>
</tbody>
</table>

A possible complication lies in the fact that Riverview Sands may well have pulled their plant back from the end of Epsom Road before permission is given to extract the river bank reservations and the river bed. Under these circumstances the commercial operators may find it uneconomic to extract this material, due to the distance from the Chipping-Norton shore-based plants. If the staged sequence outlined in Section 6.8 can be implemented the previously estimated completion dates could probably be adhered to. If commercial operators cannot be interested in recovering this material, the time scale could be extended.
The estimated completion dates for material mineable subject to the present restrictions, lie within the time limits set by the agreements with the Liverpool Council. If additional reserves are made available to the companies, there may be some desire on the part of the companies to sequence their extraction in a different manner to that envisaged under present conditions. Consequently the granting of additional sources should be subject to an overall sequence of completion being agreed to between the 'Lakes Authority' and the companies, in order that the extraction results in an orderly formation of the lake.

The times estimated depend largely on the assumed production or selling rate of the companies. It should be noted that, in turn these depend on digging conditions encountered and the level of demand. All three companies can produce at rates in excess of those quoted above, and it is conceivable that dates for completion could advance by several years, if there is sustained demand for the products.

This factor should be considered during deliberations on the urgency required in setting up a 'Lakes Authority' since already opportunities to simplify the progression to a final lake amenity are being lost due to the speed with which extraction is being completed in some areas.

6.8 Practical Completion of Lake

As discussed in previous sections it is important and urgent that a plan to completion of the lake be prepared and administered under the guidance of a single authority. The complete legislation to vest control in this authority may take time. In the interim all the engineering and the basic plan should be put in hand.

Areas now being mined by dredge would be completed to plan and profile by floating plant. Areas being dry-mined would be flooded and then completed to plan and profile also by floating plant.

To carry out the work economically and with the maximum co-operation and potential royalty contributions of the companies concerned, very early decisions and agreements would be necessary regarding the closing of roads, mining of 2 chain reserves and formation of islands.

Alternatively if the timing is not possible, or if otherwise decided, the 2 chain reserves could be left and mined later either by a lakes authority owned dredge or by tenders or negotiation with mining companies still in the area.
Whichever method is adopted, the retreat must be staged so that there is a dredge-base and truck access close to the centre of the dredge operations. The dredge line for economical operation would be limited to about 300 m radius. An indication of the sort of clean-up and retreat plan envisaged is shown by Figure 20. Of course the actual plan could be varied to suit the final decisions and circumstances.

Events are now moving quickly in the northern area of the lake, particularly with regard to Riverview Sands' dredges along Epsom Road. A plan of action for this portion of the lake would be required within about 2-3 months if the co-operation of the company is to be sought regarding the 2 chain reserves. Otherwise there are the alternative clean-up methods mentioned above.

6.9 Proposed Lake Boundaries

The original lake boundary in its simplest form was proposed by the Munro Report, as shown dotted on Figure 11. However, to take account of actual mining that has already occurred beyond the original shoreline and also to make the lake more attractive, it would be logical to vary the shoreline in the manner shown in the heavier line on Figure 11. This variation would have no disadvantage technically, but be a more practical proposition. The Figure 11 boundary would form the basis of an immediate plan to work to but could of course be altered as work proceeds or according to the needs of later detailed planning.

Waste products from the mining would be economical for reclamation and beach formation as discussed elsewhere. Timely directives to the mining companies would enable them to assist with the placing of waste to the best advantage, and at minimum cost.
LEGEND

- CURRENTLY MINEABLE PLUS ROADS AND EASEMENTS.
- RIVER BED AND 2 CHAIN RESERVES.
- UPSTREAM FAIRING
- PLANT SITE

NOTES

The dates shown are those estimated for completion of extraction to the colour limits shown, assuming frozen reserves are made available in the immediate future.
KEY & NOTES

1. SUGGESTED FINAL ISLANDS LEFT FOR RECREATION OR SANCTUARY PURPOSES AND TO PRODUCE WAVE BREAKS AND PROTECT BANKS.

2. RECREATION OR OPEN SPACE BOUNDING LAKE SHORES

3. ORIGINAL LAKE BOUNDARY

4. PROPOSED ACTUAL LAKE BOUNDARY TO REAL ACCOUNT OF CURRENT EXCAVATION AND TO IMPROVE LANDSCAPING

5. BOUNDARY OF CHIPPING AUTHORITY

6. RESTRICTED DEVELOPMENT ZONE 50 M FROM SHORE

7. AREA SWEEP BY CRESCENT IN CLEAN UP AND SAND REMOVAL OR PROFILING

8. STAGES ONE TO FOUR SHOW POSSIBLE PLANNED CLEAN UP OF ALREADY EXCAVATED AREAS AND DRY TO 6% RISE AND REMAINING 2 CHAIN STRIPS AS WELL AS FORMING OF FINAL BEACHES AND ETC. AS AGREEMENT WITH COMPANIES, AS THEY WIND UP OPERATIONS OR BY LAKE AUTHORITY'S OWN CRESCENT OR BY NEXSANDS LTD.

9. STAGE FIVE CLEAN UP WOULD RANGE COMPLETION TO PLAN OF AREA NOT YET DREDGED AND COULD BE BY AGREEMENT WITH HOLLYWOOD SANDS LTD.

SCALE METRES

PRACTICAL STAGED COMPLETION OF LAKE

FIGURE 20
7.0 PLANNING REQUIREMENTS AND ENGINEERING

7.1 Planning Requirements

As previously established, the engineering aspects divide into two separate but overlapping activities:

1. Immediate action to control and co-ordinate the extraction towards achieving the lake, on an interim scheme based on the planning and engineering available or readily obtainable.

2. Longer term development planning of all aspects of the lake including:
   - environmental studies and scenic planning
   - hydraulic engineering
   - bank and beach design
   - staged development for ultimate land use of foreshore areas

The former would be primarily concerned with directing the current mining activities towards proper and orderly development of the lake, on the basis of the general concept which was endorsed by the Georges River Extractive Industries Committee.

Activity 2 would involve firstly essential engineering investigation and design for the lake and shoreline and secondly the more gradual evolution of a master plan for development of the foreshore parks and lands. This would be done in consultation with interested or affected parties such as Councils, other interested state government departments including Planning and Environment, and Lands.

Essentially the above division separates the urgent action required on the lake itself (the existence or benefit of which is considered to be not seriously in question), from the foreshore land use which requires considerably more development and consultation.

Figure 21 shows a preliminary development programme. This broadly defines the priorities and timescales involved, but would be subject to modification as problems become more defined.

7.2 Scenic and Environmental Aspects

Apart from the rather scarred areas where mining has or is being practised, there remains a considerable amount of pleasant foliage along the river banks and on the remaining 2 chain reserve strips. The photos at the end of this section provide an idea of the existing scenery. It is suggested that as much as possible of the existing trees and foliage be retained.
LEGEND;

ADMINISTRATION
GENERAL
Control of Trust Fund—annual accounts
—day to day running
Progress Report
Control of govt funding allocations
Liaison—Councils, public, inter-departmental & others
Negotiation of new agreements with sand extractors including extraction of roads, river bed & bank remnants

LAND ACQUISITION
—of lake foreshores for recreation & lake servicing, etc.

SURVEY
—Authority boundaries
—Associated work with land acquisition—searches, legals etc.

SAND EXTRACTION CONTROL
GENERAL
—Field inspectors & policing
—Check surveys
—Reporting on Company view & extraction schedules

INVESTIGATION
Detailed soil investigation and design of stable foreshores within lake proper
Data collection programme and detailed investigations and designs for upstream and downstream works
Lake Foreshores Development Plan including overall Environmental Impact Statement

CONSTRUCTION

FIGURE 21
Environmental Impact

The mining has of course a considerable impact both on the landscape and the local community (trucks, blown sand, turbidity in the river, etc.) But as this has been an established industry for many years and one which will now gradually withdraw as the deposits become exhausted, no useful purpose would seem to be served by carrying out an environmental impact study now for the extractive industry itself in this specific area, although there is scope for alleviating the impact on the community.

However, in master planning for the ultimate foreshore land development, an environmental investigation would be utilised to determine the optimum land usage.

The overall potential benefit of the lake to a community otherwise distant from beaches need hardly be questioned. The planning of the lake should be such that diverse activities can take place side by side without friction, e.g. picnicking, sailing dinghies, swimming would be compatible, but the use of high powered boats may have to be limited.

Sand mining at Chipping-Norton and pollution of the upper reaches of the Georges River have received a good deal of publicity, particularly following a recent publication by the Macquarie University Committee of Environmental Studies. It is not proposed to discuss the findings of this and related press reports in detail, but in the opinion of the SL & M report many of the statements appear to be exaggerated or distorted compared with a balanced assessment of the facts.

It should be remembered that the extracted products are put to good use within the Sydney region and are essential to the city's development. The most sensible course of action is to see that not only is the lake scheme properly developed, but also that the material resources are not wasted. Properly handled these goals are compatible.

7.3 Water Pollution Aspects

The matter of water pollution in the upper Georges River is considered to be a separate issue from the formation of the lake, since the lake itself will exist as a body of water, regardless of the quality of that water.
On the beneficial side, the lake will significantly increase the tidal prism near the headwaters of the tidal part of the Georges River, representing a net increase in the volume of water being exchanged with the ocean on each tidal cycle. This exchange could be expected to have an appropriate increase in the rate of removal of dissolved pollutants. In addition the greatly increased surface area of the lake, as compared to the former river surface area, could be expected to diminish pollution because of the great capacity for air entrainment, as assisted by wave action on the lake's surface.

On the debit side, the lake bed will be deeper than the surrounding river bed, and the lake could act as a sink for heavy pollutants and fluids. These might be concentrated with time during dry periods but would be flushed out by floods.

However it is considered the dilution factor involved should be sufficient to eliminate any potential adverse effects, but the question must be investigated further. Of course the elimination of the sources of pollution is the obvious long term solution.

7.4 Turbidity from Dredging

The final lake would take shape over say the next 7-15 years as the commercial sand deposits are exhausted. But within 1-2 years, following the removal of Epsom Road (see drawings) a large portion of the lake could be available for use.

Dredging would then continue in parallel with the development of recreational facilities. Provided certain safety precautions and procedures were observed, this would be possible. Indeed there are many instances in lakes and harbours where dredging and recreation co-exist. The turbidity caused by the dredging is noticeable but not necessarily damaging, and compared with flood turbidity following rainstorms, rather insignificant. Provided dredging were ceased at weekends or holidays the water should have cleared for the peak recreational period.

7.5 Stability of Foreshores

The lake will be a large open body of water some 2.4 km by 2 km upon which winds will generate waves capable of damaging the banks. This contrasts with the original meandering river channel set within sheltering high banks. The waves which could be set up in a moderate gale (80 km/h) have been calculated for a number of points around the lake as shown by Figure 22. Waves up to 1 metre in height could easily occur on long stretches of the lake foreshore. These are very much more destructive than would have existed previously, including the wash from boats.
Maximum significant wave heights due to wind speeds of 80km/h:
(Wave period: 2-3 sec.)

- : 0.6m.
- : 0.6 - 0.9m.
- : 0.9m.

HEIGHT & DISTRIBUTION OF WIND WAVES AROUND LAKE FORESHORES

FIGURE 22
SCHEMATIC REPRESENTATION OF ALTERNATIVES FOR BANK STABILISATION

FIGURE 23
upstream end and extending progressively out into the lake.

Unisearch has carried out some work on this matter and it is agreed that sedimentation will not present an obstacle to navigation for the next 100 years at least.

In the event of sedimentation ultimately becoming a problem, the cost of maintenance dredging could be mostly offset by the revenue gained from the sale of the sand fraction of the dredged material.

7.7 Tidal Ventilation

Unisearch carried out model studies which (subject to the limitations implicit in these studies) indicated that the tidal ebb and flood currents penetrate all points of the lake. Consequently there should be no stagnant areas.

The overall efficiency of the tidal exchange in the lake will depend primarily on the degree of stratification within the main body of water in the lake. During normal flows the effect of tidal currents, waves and boats will tend to promote turbulent mixing but stratification within the lake could persist resulting in accumulation of heavy solutes and detritus in the lake depths (see Section 7.3).

It is considered that tidal ranges will not be significantly altered by the completion of the lake.

7.8 Effect on Flood Behaviour

The construction of the lake itself and unrelated activities such as residential development on the flood plain are altering the characteristics of floods both upstream and downstream of the lake.

In any reach of a river the flood flow into that reach flows either out onto the flood plain or out of the downstream end of the reach. The volume of water temporarily stored on the flood plain is called valley storage. The difference between volumes of inflow and outflow is equal to the change in valley storage.

The primary effect of the presence of the lake will be a marked decrease in head loss through the area occupied by the lake. This will result from the enlargement of the channel section, the reduction in the effective river length and the elimination of the sharp bend at Chipping Norton.

Assuming little change in the flood levels downstream of the lake, the decreased gradient through the lake will lead to reduced flood levels at the upstream end. These reduced flood levels will mean a corresponding reduction in valley storage with a resultant increase
in the river channel flow coming out of the lake at the downstream end. This increased flow out of the lake should cause a small increase in flood levels downstream.

Offsetting this, excavation of material beyond the normal river level will provide additional storage up to a bank-full flood, but once a flood has overtopped the river bank this addition is fully used up and no longer contributes to new storage for the rising flood.

Based on the limited data available an analytical model of the river was used to examine the effects of the lake construction on the flood of 1964. Although this was not a major flood, it can be considered as one of the more common floods upon which the effect of the lake will be noticeable.

The analysis confirmed that downstream of the lake the flood levels would be only slightly increased (approximately 3 inches immediately downstream of the lake and no significant change at East Hills). Upstream of the lake there would be a reduction of peak flood levels varying from approximately 5 feet immediately upstream of the lake and decreasing to approximately 2 feet at Liverpool Weir. These effects are shown on Figure 25.

The analytical model was based on very limited data and hence the results discussed above are only preliminary. Furthermore the analysis assumed that the lake construction was the only significant change in the flood plain and river bed. However, it should be noted that a number of areas of the flood plain have been filled for garbage disposal or urban development with an associated loss in flood plain storage.

Consequently it would be wrong to attribute any changes in flooding solely to the lake construction.

A physical model study carried out by Unisearch generally confirmed the magnitude of flood level changes calculated and also extended the results to a range of flood magnitudes. It is significant that the model showed that as the magnitude of the floods increased, the effects of changes on the flood levels decreased.

In summary, while the effect of the lake on flood levels needs thorough study, indications are that the problems can be coped with.

7.9 Effect on River Regime

Below Liverpool the Georges River comprises a channel kept open by fresh and tidal flows through a bed of alluvium brought down by the river. The regime concept is that the natural channel is the result of a dynamic interplay and balance between such factors as the flow in the river, the type and amount of sediment available and the velocity of flow. The principles of
PEAK FLOOD LEVELS - PRE & POST LAKE CONSTRUCTION

Recorded peak flood levels for the 1964 flood.

Estimated peak flood levels for 1964 flood after lake construction - assuming no other factors in the flood plain have changed since 1964.

Figure 25

Flood level (standard datum)

Distance

Liverpool Weir
Cabramatta Creek
Reserve Road
Prospect Creek
Milperra
East Hills

Proposed lake
regime theory are mainly empirical and a good deal of judgement and basic data of the particular river are necessary before quantitative assessments can be attempted. Nevertheless, the broad concepts are sufficient to indicate the direction of trends in river behaviour likely to be initiated by the full construction of the lake.

It is considered that upstream of East Hills the river regime is dominated by fresh water flow. Tidal velocities in this area are about one foot per second and are insufficient for the movement of the river bed material (viz. D65 approximately .35 mm). The presence of natural levee banks in the area further indicates the dominance of fresh water flow on the river regime.

Regime Parameters Changed by the Lake

In the discussion of flood effects it was noted that the lake will increase the average flood discharges in the downstream reaches of the river. The increase, however, will only be slight and should not have a significant effect on the river downstream of the lake.

Of far greater significance is that the lake will act as a sediment trap in the river. The bed load that normally was carried down the river will be deposited in the lake. The very fine sediment load will tend to pass through the lake before it has time to settle. The result to the downstream river regime will be manifest as a decrease in quantity and grain size of the sediment carried by the river.

Upstream of the lake the large decrease in flood levels will induce significantly steeper flood gradients and higher river velocities. The effect will extend as far as Liverpool Weir and only to a minor extent beyond because of the regulatory effect of that weir.

Likely Changes in River Behaviour Downstream of the Lake

The river, downstream of the lake, will adjust to the changes in sediment charge and river discharge. Initially the river will endeavour to restore the sediment charge to one which is compatible with the existing river slope and sediment grain size. This will be achieved by a tendency for the erosion of sediment from the bed and banks of the river. The impact will be felt, first, immediately downstream of the lake. The impact on areas further downstream would be delayed because the sediment eroded from the river upstream would tend to partially restore river sediment loads downstream to prelake values. The trend would be a progressive adjustment downstream.

River erosion will establish a new regime balance in keeping with the reduced sediment discharge coming out of the lake. Current expert opinion is that the river
will ultimately tend towards an increase in depth and a reduction in river slope. In the short term this increase in depth will tend to induce some bank instability. At Milperra, which is only a short distance downstream from the lake area, there is a sharp bend in the river. This has been unstable in the past and there has been some attempt to stabilise the outer bank near the Milperra road bridge. It is considered Milperra could experience more frequent bank stability problems once the lake is fully constructed and will require future surveillance and possible further protection.

These conclusions have been compared to the results of an investigation carried out by Unisearch which used a completely different approach. The conclusions are essentially the same.

In general the Georges River does not carry a large sediment load and as such it is considered that regime adjustments by the river will not be major and will occur as gradual changes over a considerable time, enabling maintenance works to be foreseen.

Superimposed on the problem of river adjustment as a result of the lake, is the effect on river behaviour of urban floodplain development. Recreation, residential and industrial reclamations have reduced flood plain storage and dammed existing and potential floodways. The result is increased discharges through the river channel and higher flood levels. These effects will tend to further upset the river balance and hasten the adjustment of the river to a new regime. It is considered that the regime effects of present and planned urban development on the flood plain are of much greater magnitude than the effects of the lake.

Sand dredging in the river has been carried out downstream of the lake area. It is possible that deepening by such dredging will offset the regime adjustments by the river that could be expected as a result of the lake. If this be so then the change in river behaviour would be greatly reduced.

Likely Changes in River Behaviour Upstream of the Lake

(a) Immediate Effects

The large reduction in flood levels upstream of the lake will produce significant reductions in tailwater levels at Liverpool Weir. This will have the effect of increasing the head loss (difference in water levels) across the weir as well as increasing the range of flood discharge for which the weir controls flood levels upstream.
The overall impact of these factors on the weir will be a pronounced increase in the water turbulence below the weir. This increased turbulence will cause scouring of the bed and banks of the river and could undermine the toe of the weir and endanger its structural stability. It should be noted that the weir is already showing signs of deterioration due to age and has recently been reinforced by Liverpool Council.

(b) **Long Term Effects**

The river, upstream of the lake, will adjust to the changes in river water surface gradients and velocities. The existing average sediment load carried by the river will be incompatible with the increased gradient and velocities. Initially the river will erode its bed and banks thereby increasing its sediment load towards that compatible with the increased gradients and velocities.

The erosion by the River will tend towards an increase in river width and depth. This will in turn reduce river gradients and velocities such that a regime balance between the new channel and the average sediment load of the river will tend to be established. If this were allowed to occur the river would re-establish lower flood gradients as far as Liverpool Weir. Ultimately, the decrease in upstream flood levels caused by the lake would tend to be concentrated at the weir.

The implication to the weir stability is that while the weir may withstand the immediate turbulence, the problem will deteriorate with time. It is considered that these effects will exceed the original design capability of the weir and its re-structuring or replacement would then be unavoidable.

As a wider issue, the overall engineering investigation and design would need to examine the usefulness and need for the weir at all in the future. However, for purposes of cost budgetting, allowance has been made for replacement of the weir as an upstream work.

**Summary of Regime Effects**

(a) The construction of the lake will tend to produce erosion downstream. In general the erosion will be long term and is not likely to be severe except at Milperra where an existing problem could be aggravated.
Development on the flood plain has a greater impact on the river regime than the proposed lake. An erosion problem already exists at Milperra due to the restrictive nature of development on the flood plain in that area.

River stabilisation works downstream of the lake are likely to involve only the Milperra area.

Immediately upon construction of the lake the structural stability of Liverpool Weir will be suspect and in need of detailed investigation, including establishing whether there remains a fundamental need for the weir at all.

Significant river erosion and bank instability is likely upstream of the lake. Detailed investigation is required to design appropriate measures to offset, or contain within limits, any such erosion.

The effect of reduced flood levels would be a critical increase in the instability of the weir. In the long term the re-structuring or replacement of Liverpool Weir would be inevitable if the weir is to be retained.

The present absence of adequate basic data on the Georges River precludes any quantitative estimates of the magnitude and time scale involved for the likely changes in the river.

The whole question of regime has been discussed at length to illustrate the complexity of the problem. Fortunately there would appear to be sufficient time available in the overall programme for a detailed investigation and analysis to confirm the magnitude of changes and determine the extent of works or measures required.

A suitable data collection programme could be expected to span over a period of at least five years and would involve an annual expenditure of approx. $24,000 giving a total expenditure of $120,000. A breakdown of a suggested programme is shown in Table 2.
<table>
<thead>
<tr>
<th>YEARS</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>TOTAL</th>
</tr>
</thead>
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<tr>
<td>Hydrographic Survey of River from East Hills to Liverpool Weir with establishment of permanent marks for further survey monitoring.</td>
<td>10,000</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
<td>30,000</td>
</tr>
<tr>
<td>Installation of automatic River Recording Stations - Maintenance &amp; calibration.</td>
<td>15,000</td>
<td>2,500</td>
<td>2,500</td>
<td>2,500</td>
<td>2,500</td>
<td>25,000</td>
</tr>
<tr>
<td>Current flow measurement.</td>
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<td>2,000</td>
<td>2,000</td>
<td>2,000</td>
<td>2,000</td>
<td>10,000</td>
</tr>
<tr>
<td>River Sediment analysis.</td>
<td>2,000</td>
<td>2,000</td>
<td>2,000</td>
<td>2,000</td>
<td>2,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Drilling and soil testing of banks.</td>
<td>4,000</td>
<td>4,000</td>
<td>4,000</td>
<td>4,000</td>
<td>4,000</td>
<td>20,000</td>
</tr>
<tr>
<td>25% Contingencies</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>25,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>120,000</td>
</tr>
</tbody>
</table>
KEY TO PHOTOGRAPHS

FIGURE 26
1. Typical River Reach

2. Foliage on 2 Chain Reserve Strip
3. Typical N.W. Bank

4. N.E. Bank – Note: re-instated "2 Chain" Barrier
5. Heavy Foliage Along South Bank

6. Residential Land Bounding River on Bankstown Side, Downstream End of Lake
7. Farley & Lewers Dredge

8. Open Pit Extraction
8.0 COSTS AND FUNDING

8.1 Cost of Lake Development

Funds will be required to develop the lake and foreshores. On present costs the order of magnitude of the development costs are estimated to be:

<table>
<thead>
<tr>
<th>Item</th>
<th>$ million</th>
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</thead>
<tbody>
<tr>
<td>Land Purchase</td>
<td>1.0</td>
</tr>
<tr>
<td>Engineering and Extraction Control</td>
<td>1.2</td>
</tr>
<tr>
<td>Investigation and Model Studies</td>
<td>0.2</td>
</tr>
<tr>
<td>Beach Formation and Bank Works</td>
<td>1.6</td>
</tr>
<tr>
<td>Downstream Works</td>
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<tr>
<td>Upstream Works</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$6.0 million</strong></td>
</tr>
</tbody>
</table>

The estimated rate of this expenditure is shown on the cash flow diagram Figure 27, at the end of this section.

8.2 Minimising of Expenditure

Compared with more definite costs of constructing actual items such as buildings, wharves, etc., there is considerable scope for variation in many of the works necessary for the lake. A cost conscious approach, coupled with careful planning and ingenious engineering to meet the objectives should offer considerable savings.

Minimising expenditure could include:

(i) Allowing banks to beach-out naturally wherever possible, with the amount of revetment construction being kept to a minimum.

(ii) The enlistment of co-operation from the mining companies so that they have a plan to work to at an early stage and can assist in forming and landscaping the islands and shoreline as they complete excavations. This would involve the companies in very little extra cost and enable waste materials to be judiciously placed where they will do the most good, and with a minimum double-handling.

(iii) Early purchase of land is considered essential to permit the detailed planning of future extraction to ensure maximum exploitation of savings under (i) above and to determine our optimum overall plan for the scheme. This substantial early investment would be offset to some extent also by appreciating land values as a result of inflation and/or betterment due to enhancement of the area by the proposed scheme.
The key to success in minimising costs will lie on being able to gain the earliest possible co-ordination of the extraction activities towards the final lake development and in being able to bring a strong engineering team to bear on the planning and design at the earliest possible time.

8.3 Sources of Funds

Possible sources of funding, other than directly by the State Government would include:-

(i) Grant or Subsidy by Federal Government
(ii) Present funding arrangements for the purchase of Country Open Space Land
(iii) Donations by mining companies
(iv) Royalties or taxes on sand mined
(v) Contributions from local Councils (ratepayers money)

* (vi) Lease or sale of land to private enterprise:- club, motel, etc.
* (vii) Licence fees for operating kiosks, boat hire, etc.
* (viii) Entrance charges
(ix) Tax savings shared between companies and the authority

* (x) Use of land for State institutions

Subject to the concurrence of the Minister for Lands

(i) GRANT OR SUBSIDY BY FEDERAL GOVERNMENT

The Federal Government presently provides grants on a regional basis for worthwhile projects benefiting the community. Such grants are normally paid to the regional Councils. On the face of it, the creation of this lake in an area otherwise removed from waterside amenities should qualify for a Federal Regional Grant. The main problem is that the lake is at the confluence of three separate regions. It would require a good deal of co-operation on the part of the three Councils and their regions (each region comprises several Councils) in order to present a united application for a Federal grant, or alternatively separate but co-ordinated applications from each region.

Whilst the division of regions does complicate matters, it would be a pity for a potential source of funds not to be fully exploited on account of possible administration problems or even parochialism.

The amount of money from this source is indeterminate at this stage and would possibly depend on the amounts
available from other sources, but say $500,000 over a period of 3-5 years might be a reasonable minimum request.

(ii) **COUNTRY OPEN SPACE GRANT**

The State Treasury presently subsidises the purchase of land for Country Open Space use. Most of the land required for foreshore use already comes under this heading (see Fig.12), so that the lake scheme will only implement what was originally intended.

(iii) **DONATIONS BY MINING COMPANIES**

The mining companies might be willing, as a gesture of goodwill, and in return for acknowledgement, to make some donation towards costs of planting trees, and landscaping work generally. Hollywood Sands is in a sense already doing this under its agreement with the Fairfield Council. Presumably such donations would be tax deductible. The possibility of the companies contributing in return for extended mining rights has been discussed more fully in Section 5.

(iv) **ROYALTIES OR TAXES**

Royalty or tax payments upon frozen reserves in river and 2 chain strips is discussed fully in Sections 5 and 6 where it was estimated up to $2.0 m worth of royalties could be available; this should yield say at least $1.5 m for the lakes authority, over the next 10-15 years, after allowing for some islands and other local uses for the available material.

In addition, the Hollywood Sands agreement with its 10¢ "so-called royalty" would provide about $250,000 further revenue to the lake.

As an alternative to receipt of royalties from the frozen reserves, the authority could employ its own dredge to commercially exploit this sand as well as clean up the lake. This matter would have to be examined in conjunction with overall planning, but it should be noted that the bulk of the sand produced in the area is consumed by ready-mix concrete plants, and by industries closely associated with the producers. In the event that the frozen reserves were not released to the present operators, consideration would have to be given as to where the material would be marketed.

(v) **CONTRIBUTIONS FROM COUNCILS**

The ratepayers of the district, and the Councils representing them would derive benefit from the lake including increased land values, so that it would be reasonable for some contribution to be made from the local Councils. The amount is indeterminate at this stage, but (as for licence fees), would be more a contribution towards operating costs than capital development.
(vi) **LEASES**

As a recreational area it would seem desirable that club or entertainment facilities be established in the pleasant environment of the lake. Similarly, the area is well situated and most suitable for a lakeside motel. These types of facilities would be built and operated by private enterprise, subject to terms and conditions appropriate to the overall concept of the lake as a public amenity.

Assuming a 2 ha site each, and say one motel and one club, a capital value of the lease of around $1.0 m would seem reasonable, based on typical commercial values. In terms of rent this could be $100,000 p.a.

(vii) **LICENCE FEES**

Amenities such as kiosks, restaurants, boat hire, etc., would be desirable in specific areas of the foreshore reserves and lake. Such amenities could be let to private enterprise with rental or licence fees charged according to the ability of the facility to earn revenue. These fees would be more a source of revenue to the authority to cover operating expense, rather than capital development of the lake. Accordingly no account of this possible source of revenue is included in the estimate of funds for the lake development.

(viii) **ENTRANCE CHARGES**

Whether or not entrance charges for the public should be levied is a doubtful question, as by the time collection and administration costs are deducted, the nett benefit may be small. If local ratepayers already contribute through Councils, then perhaps they should be exempt if entrance charges are levied.

(ix) **TAX SAVINGS ON RESUMPTION/LEASE BACK**

A suggestion has been made that if the Lakes Authority were to resume freehold land being mined and then lease the land back to the companies for extraction purposes, the monies paid in lease-back would be a cost against taxable income. The authority would pay the mining companies for the land over a period of say 10-15 years (the residual life of the deposit). At the same time the companies would pay the authority the lease-back annual rent. This could result in a nett return of $0.4 to 0.6 million to the Authority over the development period.

The case was put informally to an officer of the Taxation Department as a hypothetical problem. It appears that under present circumstances the concept is feasible.

(x) **USE OF LAND FOR STATE INSTITUTIONS**

The lakeside area would obviously be a pleasant place for a hospital or convalescent home. Land within the lakeshore reserve might be made available at nominal cost. In this way the State budget would perhaps be saved purchase of
land for such institutions elsewhere. The overall saving might enable State funds to be more readily available for the lake itself.

**SUMMARY**

Apart from savings created by good design and planning and revenue contributions towards the running costs of the lakes park, revenue towards development of the lake could be raised by a number of methods as outlined above. Leaving aside what the State Government might contribute the potential amount from these other sources could be in the range of $2.5 million minimum, to about $5.0 million maximum. In preparation of the cash flow of Figure 27, a revenue of $3.0 million was adopted.
LEGEND:
* cumulative expenditure
△ cumulative revenue
○ cumulative deficit

Total Expenditure $6 Million
$3 Million

CUMULATIVE CASH FLOW $10^6's

ESTIMATED CASH FLOW $1000's

<table>
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<th>CUMULATIVE EXPENDITURE</th>
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<th>CUMULATIVE REVENUE</th>
<th>DEFICIT</th>
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<td>3000</td>
<td>3000</td>
<td>3000</td>
<td>3000</td>
</tr>
</tbody>
</table>

FIGURE 27
8.4 Cash Flow

Having assessed the order of costs and income, the likely rates of receipt and expenditure were computed as shown on Figure 27. As previously discussed the highest priority should be for land purchase and the graph is based on this being done.

While the cash flow is a preliminary estimate, it may be taken as guide to the pattern of funding required for the project.
ACKNOWLEDGEMENTS

The assistance of the following persons or bodies in providing information for this report is acknowledged:

. Liverpool City Council
. Bankstown Municipal Council
. Fairfield Municipal Council
. Planning and Environment Commission of New South Wales
. Hollywood Sands Pty. Ltd
. Monier Sands Pty. Ltd.
. Riverview Sands Pty. Ltd. (Farley & Lewers)
. Quarries Pty. Ltd. (Blue Metal Industries)
. Mr. A. Skivington
. N.S.W. Sand Producers Association
. N.S.W. Geological Survey
. Dr. R. Warner, Geography Department, University of Sydney
. Peter H. Stitt and Associates
REFERENCES

The following references are quoted in the report, or have been used as general information to the preparation of the report:

1. Georges River Extractive Industries Inter-Departmental Committee Report to the Minister for Public Works and the Minister for Local Government. (Including University of N.S.W. Water Research Lab. Reports - referred to as Munro Reports).

2. N.S.W. Rivers and Foreshores Improvement Act.


4. Macquarie University Committee on Environmental Studies - "The Effects of Sand Mining at Chipping-Norton".

5. Channel Deterioration in the Georges River between Liverpool Weir and Little-Salt-Pan Creek by R.F. Warner and G. Pickup (Feb. 1973) - Department of Geography, University of Sydney.


11. Acts Referred to: -

(a) Rivers and Foreshores Act
(b) Crown Lands Consolidation Act
(c) Navigation Act
(d) Local Government Act (Liverpool and Fairfield Ordinances)
(e) Pollution Control Commission Act
(f) Mining Act
(g) Cooks River Improvement Act 1946
(h) National Parks and Wildlife Act 1967
(i) Returned Soldiers Settlement Act
(j) Land Aggregation Tax Management Act
(k) Closer Settlement Act

OTHER SOURCES OF INFORMATION

In addition to the specific references above, information in the form of miscellaneous borelogs and data was obtained from the mining companies and other sources mentioned in the acknowledgements.