Penrith Lakes - Towards 2000

Peter McGhee

Penrith Lakes Development Corporation Ltd

Introduction to the Penrith Lakes Scheme

The Penrith region has been a major source of supply of sand and gravel to the Sydney construction market since the late 1800's. Originally, these resources were won from the Nepean River. By the late 1950's the resources in the river were depleted and the operating companies at that time turned their attention to the Castlereagh floodplain, just north of Penrith.

The floodplain contained some 200 million tonnes of sand and gravel and was primarily used for agricultural activities such as dairies and orchards. The operating companies purchased individual farms and sought Penrith City Council's approval to undertake sand and gravel extraction operations. Individual applications were approved by Council based on the merit of the application. At that time, community expectations of environmental issues were virtually non- existent and conditional approvals very rarely contained any requirements related to rehabilitation.

In the late 1960's Council began to raise concerns regarding the long term future of the floodplain. Council's concerns reflected the increasing community expectations in environmental matters. A Working Party was established by the then State Planning Authority. It comprised of representatives from the SPA, Council and the operating companies. The Working Party, funded by the companies, investigated possible solutions for the continued extraction and final rehabilitation of the floodplain.

A report recommending that the final rehabilitation be directed toward a lakes scheme was finalised in 1974. While the report promoted the concept of a large lake system, there were several major technical shortcomings in the concept, principally, there was no identified source of water to supply the lakes with appropriate quality water. The report, however, did provide a vehicle by which the operating companies could direct their attention to corporate matters. In 1979, the then operating companies entered into an agreement for the implementation of the Penrith Lakes Scheme.

Penrith Lakes Development Corporation Ltd.

PLDC was formed as part of the shareholders agreement. It commenced operations in 1980 with the principal functions of:

- obtaining the necessary approvals to implement the Penrith Lakes Scheme,
- coordinate quarry and rehabilitation operations, and
- ensure that the operations are undertaken in an economic and environmentally acceptable manner.

PLDC is empowered by the shareholder companies to acquire lands held by them and to purchase any lands necessary to implement the Scheme. At the time the shareholders agreement was put in place, the shareholders held approximately 70 % of the 2,000 hectare site. It was PLDC's responsibility to purchase the additional lands, if required, or design the Scheme to suit landownership.

Through corporate rationalisation which occurred in the 80's the shareholder companies of PLDC are now:

- Boral Ltd.
- CSR Ltd. &
- Pioneer International Ltd.

The Corporation is responsible for the extraction of the sand and gravel (raw feed) and subsequent rehabilitation work that would otherwise been carried out separately by the shareholder companies. By the sale of raw feed to its shareholder companies, the Corporation raises sufficient revenue to meet its operating costs associated with the implementation of the Scheme. The shareholder companies process the raw feed in their individual plants and market their product in competition.

Planning the Scheme

Under the Environmental Planning & Assessment Act 1979, quarrying is identified as a designated development. As such, any application to undertake development must be supported by an Environmental Impact Statement. Penrith City Council would be the consent authority for any development application lodged for quarrying under the planning instruments which were in place at the time PLDC commenced its operations.

However, in view of the complex regional and technical issues related to the Scheme, the then Department of Environment and Planning considered that the Scheme should not proceed unless it was considered in a broader overall planning framework. The Department consulted with Penrith City Council regarding the planning approach to be adopted, and received their support to put the Scheme into a regional context. This approach requires that a Regional Environmental Plan be prepared, which is preceded by a Regional Environmental Study. The Minister administering the EP&A Act would be the consent authority under the REP and not Penrith City Council.

The DEP established a steering committee to prepare the RES. This committee comprised of representatives from the DEP, Penrith City Council, the Water Resources Commission, the Department of Mineral Resources and PLDC. A special sub- committee was created to address the complex water issues. This committee comprised of representatives from the Water Resources Commission, the State Pollution Control Commission, the Water Board and PLDC.

Commonly held objectives of these committees were that all regional issues related to extraction of the resource be evaluated to permit orderly and economic development, while promoting the social and economic welfare of the community and protecting the environment.

The RES process addressed a variety of design concepts, which were progressively refined as emerging issues were clarified or fixed. Each concept was tested for financial, technical and environmental feasibility. In all, the process went through four phases of refinements and evaluated some 27 conceptual designs in total. At the conclusion of the process, three

designs were promoted as being possible feasible quarry and rehabilitation solutions. These designs were :

1. **The Large Main Lake Scheme** - which maximised recreational benefits.
2. **The Small Main Lake Scheme** - which maintained the existing private landholders.
3. **The Wetlands Scheme** - which maximised flora and fauna benefits.

The process of evaluation ensured that each design was sufficiently robust to allow quarrying to proceed, with the final form of rehabilitation to be determined by public participation in the formal planning process. The Steering Committee identified the Large Main Lake Scheme as the preferred option.

The RES was put on public exhibition in March 1984. The Department of Environment and Planning received submissions on the RES to assist in their drafting of the Regional Environmental Plan. A draft Regional Environmental Plan was put on exhibition in April 1986 and, following the receipt of further submissions, Sydney Regional Environmental Plan No. 11 was gazetted on November 18, 1986. The total planning process took almost 6 years.

Deed of Agreement

The gazettal of SREP No.11 provided the legal framework under which the Penrith Lakes Scheme would be implemented. It does not establish the rights and responsibilities of the parties involved in the implementation. These issues are addressed in a Deed of Agreement between PLDC and the NSW Government which was formally executed in August 1987.

The 1987 Deed details the working arrangements agreed upon by the two parties to ensure that the Scheme is constructed and managed in accordance with the general principles embodied in the RES and SREP No. 11. The Deed also details construction and environmental performance standards to be achieved in implementing the Scheme. Frequent reference is made to the Deed arrangements in the following sections.

Quarrying

Quarrying has been part of Penrith for over 100 years and many of today's activities in and around Penrith are associated with the quarry industry. The resource contained within the Scheme area is medium to coarse grained sand and river gravel. These resources are products for the general construction industry, providing materials for the production of concrete, road construction material and the like. Current extraction levels of 5.4 million tonnes per annum from Penrith Lakes provides approximately 80% of Sydney's market for the products which it can supply. It is a regionally significant resource and complements the Government's Metropolitan Strategy.

The floodplain is made up of a 7 to 8 metre layer of sand and gravel (raw feed) which sits upon a shale base. The level of the shale base is some 3 to 4 metres higher than the normal

water level in the adjacent Nepean River. On top of the raw feed is a 7 to 8 metre layer of fine sands and silts (overburden). This material is used to construct the final landforms in the Scheme. A thin layer of medium to poor quality topsoil sits upon the overburden. The topsoil is used in rehabilitation works.

Quarry operations involve the removal of the overburden to expose the raw feed. About 6 months supply of raw feed is exposed to ensure adequate supplies during adverse weather conditions. Once exposed, the raw feed is extracted using large excavators servicing a fleet of 85 tonne off-highway trucks. The raw feed is then transported to separate processing plants where it is screened, crushed and washed to produce a range of products to meet various construction specifications. Daily production rates of about 25,000 tonnes are necessary to meet demand.

The overburden is stripped using either a fleet of open bowled scrapers or a fleet consisting of an excavator and 85 tonne off-highway trucks. Haul distance and production rates determine the fleet type. Typically, daily production rates of 12,000 to 15,000 cubic metres are required to maintain an adequate level of exposed raw feed. The overburden is transported to previously quarried areas, placed, shaped and compacted to form landforms in accordance with final designs and specifications.

Topsoil is stripped as a separate operation. It is transported direct to completed landforms, placed, spread and trimmed ready for the commencement of rehabilitation operations. In some circumstances remedial works are necessary to bring the topsoil up to an appropriate standard for the quick establishment of grass cover.

The quarry process is relatively simple in terms of its component parts. However, it is very complex in terms of scheduling the works to maintain efficiencies. There are a number of basic principles which must be observed in scheduling the works:

- fill areas must be available to accept overburden,
- haul distances to processing plants must be minimised,
- overburden haul distances be minimised consistent with final design,
- stripping areas must be available (DA approved, heritage items resolved),
- provision made for existing and future haul roads,
- provision made for drainage and dewatering operations.
- environmental issues , Deed and consent conditions be considered.

PLDC uses a standard mining software package (Minex), modified to include a linear programming routine to seek optimum sequences for the works. Sequence plans are prepared at three levels:

- Scheme plans - for overall development control,
- 5 year plans - for project control,
- 12 month plans - for budgetary control.

Scheme Features

The general layout of the Scheme is shown in SREP No.11's Structure Plan (Figure 1). Total area of the Scheme is 2000 hectares. Final rehabilitation form will comprise:

- 1000 hectares of open space land
- 750 hectares of lakes, and
- 250 hectares of urban land.

Form

The final distribution of areas will depend upon many interacting issues. The Structure Plan provides the general form for rehabilitation. Detailed construction plans are prepared each two years and are submitted to the Minister for approval. Minor variations to the approved plans are permitted to account for changed circumstances or design refinement.

Water

The lakes will be, on average, 5 metres deep. The Nepean River, at a site just upstream of Penrith Weir, will provide water to maintain levels and quality in the lakes. A major pumping station will be constructed upstream of the weir to divert water into the southern most lakes in the Scheme. From here the water will gravitate to the north, via overflow pipes provided through the landforms separating the lakes. Surplus water will be discharged back to the Nepean River at the north of the Scheme. On average, some 26,000 megalitres of water will be diverted to the Scheme. Approximately 23,000 megalitres, or about 90 percent of the diverted water will be returned to the Nepean River at the north of the Scheme.

Flooding

The Scheme is being built on a floodplain, and will be subjected to flooding from the Nepean River. Generally, the Nepean River banks are above the 1 in 100 year return period flood level. Water does back up in the northern section at a much lower level due to a restriction in the flood plain about 5 kilometres downstream of the Scheme.

Flood protection systems for the Scheme must account for the less frequent flood events. The normal water level in the lakes is about 10 metres lower that the top of the river bank. If uncontrolled flood flows were permitted into the lakes, then they would access the lakes over the banks down to the lake's normal water level, travelling some 100 to 150 metres across the landforms. Soils on site are susceptible to erosion. The landforms would be quickly scoured if uncontrolled flood flows were allowed to enter the Scheme in this manner.

The Scheme's flood protection system provides for the construction of a number of flood control weirs. These weirs connect the lake system to the river system. During major flood events, flows are permitted to enter the lakes at a much lower level than would normally occur. These flows commence to fill the lakes, so that by the time the river flows exceed normal bank level, the lakes are at the same height, and the flood scouring flows are avoided.

The Scheme has about 90,000 megalitres flood storage, split between four major flood cells. Under design flood conditions, it will take about 20 hours to fill this flood storage. Flood waters will return to the Nepean River via gated flood pipes, taking some three to four

weeks to return to normal lake water level. The rate of flood storage evacuation must be controlled to prevent bank slumping within the Scheme.

Foreshores

The completed Scheme will have about 45 kilometres of lake foreshore. These foreshores will be available for public access, and represent the transition zone from neighbouring land uses. Ecologically, these areas are very special being the interface between the aquatic environment and the terrestrial environment. They need to provide access points for adjoining land uses as well as provide a habitat for associated fauna.

The susceptibility of Scheme soils to erosion is a critical consideration in the design of the foreshores. Wave action from the lakes will erode the foreshores and create inaccessible areas. Foreshore designs variables are the shape, the slope and construction materials. Generally, favourable foreshore shapes are created, complementary to the desired slope. The compacted foreshore is then covered with 500 mm of compacted sand and gravel to provide lasting protection. Special hard rock headlands are constructed at key location around the foreshore to trap any eroded sediment. These headlands are aligned to the "null drift" position and eventually beaches will form in a similar manner as the formation of coastal beaches with littoral drift sediments.

Landscape

The strong presence of the Castlereagh floodplain has a dominant influence on landscaping principles associated with the Scheme. Lake shape and landform designs are determined with a consideration of the fluvial processes which were involved in the formation of the existing floodplain. Consideration is given to maximising view quality, both from within the Scheme looking out and from the outside looking in.

PLDC has prepared a Landscape Manual which describes the principles upon which landscaping themes are to be incorporated into the Scheme. It includes foreshore design principles, landform and lake form design principles, tree selection principles and the like. The reason for preparing the Manual relates to the long period of Scheme development. The Manual provides a consistent approach to landscaping throughout the 25 to 35 year development period, avoiding a mosaic of inconsistent landscapes which may occur through the use of a variety of consultants.

Land and Lake Uses

The form of development will permit a variety of land and lake uses, the final such uses being very much dependent upon the management arrangements provided by the Minister. Western Sydney has very limited access to water based recreational areas. Potential population catchment for the Scheme is more than 1.5 million, in addition, both national and international tourist trade will contribute to the total usage of the Scheme.

Potential land uses range from passive uses such as camping, picnicking, walking and the like, to more active uses such as golf, special theme parks, horse riding and the like. Potential land uses will be partly determined the shape of the landform and proximity to the water.

In addition, the future management of the Scheme will strongly influence ultimate land uses. If the area is run similar to State Recreation Areas, then most land uses will be passive. Should a different approach be taken, and appropriate development encouraged to

participate in the Scheme, then more active land uses will eventuate. The ultimate use of the public recreation areas in the Scheme is contingent upon the direction of future management.

Lake water uses will range from swimming, canoeing, rowing, fishing and sailing to the more passive activities of sightseeing and special event related activities. PLDC is not planning on permitting power boats on the lakes. Future Scheme management will need to address this issue.

Land Matters

PLDC and its shareholders own the majority of lands within the Scheme. The balance of the lands is held by the Crown as roads, lanes, creeks and the like. There are two private landowners within the Scheme. Under the provisions of the Deed, PLDC extracts the Crown lands and pays a royalty on the volume of raw feed extracted from those lands. The royalty being determined by the market value of the land.

PLDC negotiates to purchase the remaining private landowners. These landowners have the right to extract their properties as provided under SREP No.11 or to sell for extraction by others. In the circumstance where PLDC cannot reach agreement with the landholder on purchase of the property, the Minister is then responsible for the purchase of the property and it is then treated in the same manner as Crown land.

Within the Urban Area, the Minister transfers the unencumbered title of Crown land to PLDC at market value. This allows all titles to be incorporated in the Urban Area subdivision.

Scheme Management

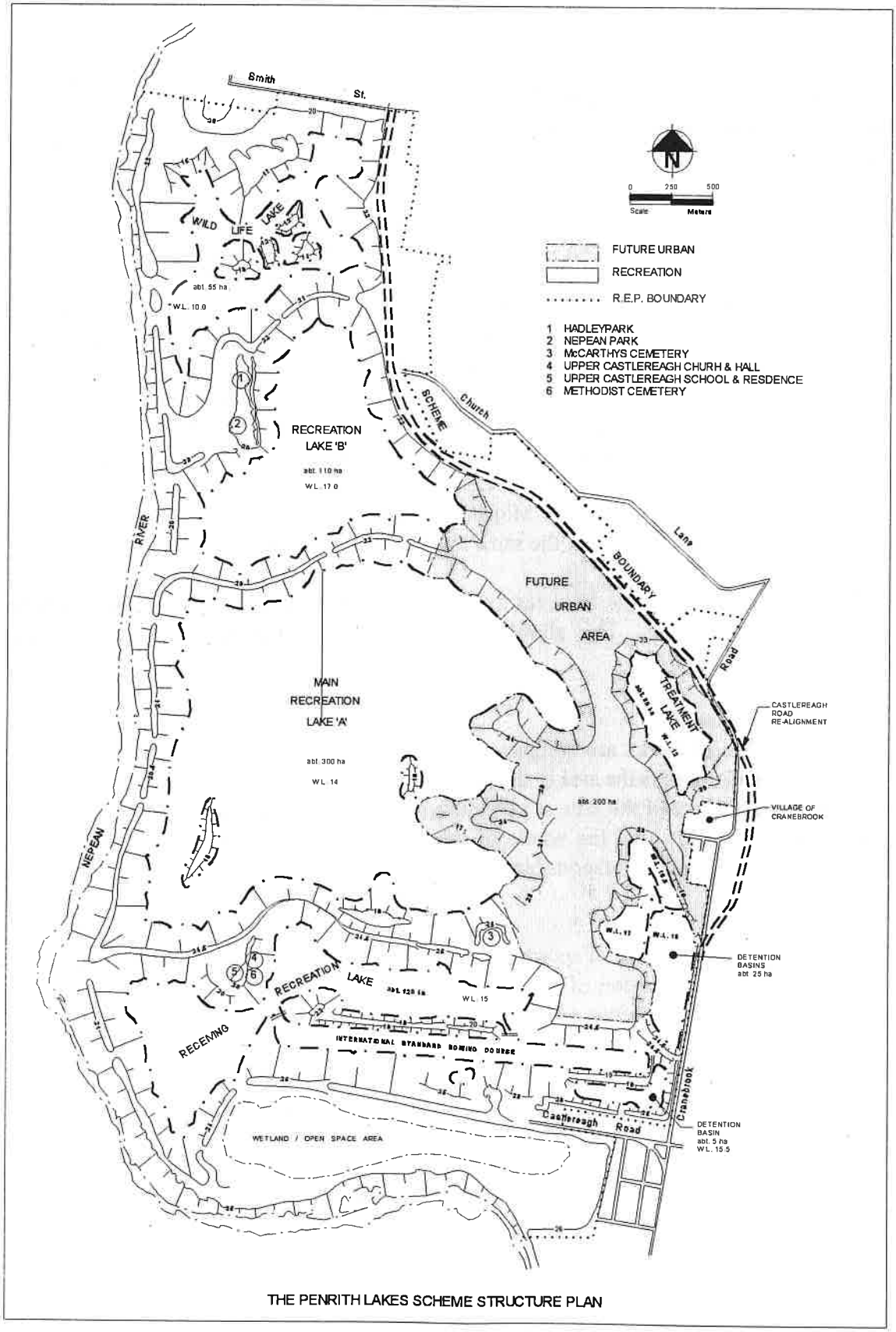
Once rehabilitation works are completed, and the area is no longer required for quarry purposes, PLDC transfers the area to the Minister. The Minister is then responsible for the ongoing management of the area in perpetuity. PLDC will retain responsibility for water management through until the whole of the Scheme is completed. Following this, the Minister will then become responsible water management.

Urban Area

The Scheme includes an area of approximately 250 hectares which will be suitable for urban development. The inclusion of this feature of the Scheme was necessary to provide a mechanism for PLDC to recoup additional rehabilitation costs associated with the Scheme.

The Large Main Lake Scheme, which maximised recreational benefits, is significantly more expensive than the Wetlands Scheme. The urban area was included to offset these additional costs.

The Minister will receive 10% of the net revenue associated with the sale of the urban lands. This return will be used to partially offset the Minister's costs associated with the ongoing management of lands transferred to him for public use.



THE PENRITH LAKES SCHEME STRUCTURE PLAN

Figure 1

Environmental Issues

A project of this magnitude and complexity will have inter-relationships with both the natural and social environments. Early planning and a whole development approach, established environmental principles for the progressive development of the Scheme. These principles need have regard to not only to the legislative regulations pertaining to the development, but also to developing favourable outcomes for the key stakeholders in the development, including the environment.

The attitude of PLDC is an important ingredient in the project's environmental management. PLDC has established close relationship's with its neighbours. It is open and frank with them and provides them with regular written information to ensure that they are fully informed of the Scheme's development. A regular open day is held to inform them of recent developments and to allow a free exchange of views and information. Individuals are welcomed and encouraged to discuss any issue of concern. PLDC makes commitments with individuals and ensures that agreed outcomes are achieved. This open attitude has played an important role in maintaining the development of the Scheme on track without the usual confrontations associated with mines.

Air Quality

Quarry operations are by their nature, prone to generating dust. The Scheme site is subjected to strong westerly winds during spring. The fine sands and silts become airborne during windy periods, originating from haul roads, pits, rehabilitation areas, neighbouring agricultural lands and road verges. PLDC controls dust generation by a combination of:

- watering haul roads,
- ceasing operations during extreme wind conditions,
- early establishment of grass covers, and
- planning extraction areas to limit duration of works near sensitive areas.

PLDC also undertakes an extensive monitoring program which includes both directional dust gauges and a concentration sampler. This monitoring is used to provide information for future modelling works, test performance of control mechanisms and for compliance with EPA licence conditions. Licence conditions are set at 4.0 grams per square metre (annual average) and 260 micrograms per cubic metre 24 hour maximum. These absolute limits are consistently achieved.

Experience shows with a particular set of circumstances, single episodic events can cause problems. During prolonged dry periods, it is extremely difficult to establish grass cover over large areas. If the dry period continues through to the spring period, which is coincident with the strong westerly winds, then dust generation will be a problem. Proper planning and timely rehabilitation work prior to spring can reduce the likelihood of problem dust episodes.

Noise
Quarry operations generate noise. PLDC manages noise levels by a combination of:

- restricting hours of operations,
- planning quarry pit development to maximise effects of shielding,
- planning works to reduce the duration of works in sensitive areas,
- constructing noise bunds in key locations,
- monitoring machinery to ensure they are properly maintained,

Careful management of noise, along with establishing close relationships with neighbours has had positive outcomes. Currently, PLDC is quarrying within 50 metres of Cranebrook Village. This residential area contains about 100 houses. Working times have been restricted to school hours in very close locations, extending to normal working hours further away. PLDC has not received any major complaints about its operations to date. There has been some isolated incidents where pumps have been left running for example. PLDC has responded quickly to these incidents and removed the noise source or made alternative arrangements. This has allowed the use of the resource to be maximised.

Erosion and Sediment Control
The soils within the Scheme area are susceptible to erosion. Lake water management requires that sediment inputs to the lakes is minimal. PLDC engaged the Soil Conservation Service on a full time consultancy basis for three and a half years. This arrangement culminated in the publication of a "Land Rehabilitation Manual" which specifically addresses the erosion and sediment control procedures to be considered in the implementation of the Scheme. Importantly, landforms are designed to incorporate drainage works consistent with the long term stability of the land. These drainage works are constructed as the landforms are being shaped, rather than as an add-on after construction.

Establishment and maintenance of sound grass covers are a critical component of the erosion control strategy.

Heritage

European Heritage: The RES studies identified some 65 items of heritage interest within the Scheme. The items included:

• Standing structures	29
• Cemeteries	2
• Ruins of structures	6
• Sites of former structures	12
• Roads and lanes	10
• River fords	4
• Landscape features	2

Development of the Scheme and retention of all these items is mutually exclusive. The Steering Committee needed to assess, on a merits basis, the heritage value of these items traded against the need to maximise recreational benefits. The REP provides for the retention of five structures and two cemeteries. Structures not to be retained will be demolished by PLDC after a detailed recording report has been prepared and any special features or items removed for inclusion in a heritage display.

PLDC has given an undertaking that it will restore the oldest structure on site - "Hadley Park". This building which was constructed before 1812 is in relatively poor condition and will require a very sensitive restoration program. The Corporation has commenced a conservation plan for the building in association with the Heritage Branch of the Department of Urban Affairs and Planning. It is expected that the restoration program will take 3 to 4 years to complete.

Aboriginal Heritage: The Scheme area was used for agricultural purposes for the last 200 years. These activities disturbed the upper soil layers of the area, diminishing the archaeological value of any sites which may contain aboriginal relics. Several sites were identified during the RES process which warranted further investigation. These sites are typically located adjacent to water courses which meander through the site.

Daruk Local Aboriginal Land Council monitors topsoil removal activities in these identified areas to ensure that any items are recorded and that the potential cultural significance of the site is acknowledged. PLDC must obtain the necessary approvals from the National Parks and Wildlife Service to destroy the site.

Flora and Fauna

Agricultural activities over the last 200 years have significantly modified the flora and fauna structures on site. There are no rare or endangered species on site, and there are no special habitats which require careful management.

Quarry operations and the resultant rehabilitation works create opportunities to enhance to flora and fauna qualities of the area. Indeed, water quality management requires the early establishment of a well structured and complete aquatic biological ecosystem. Most attention has been directed toward the more visible terrestrial ecosystem, but it is significantly important to develop and maintain the less visible aquatic ecosystem.

PLDC cultivates its own aquatic plants, as commercial quantities of these specialised plants are not available. Some 40,000 plants have been introduced to recently completed lakes. The establishment of these plants is the foundation of developing the aquatic ecosystem.

The terrestrial ecosystem will be enhanced by the development of woodlands/arboreal structures consistent with the floodplain and consistent with the area. To date some 40,000 trees have been planted in previously rehabilitated areas and adjoining land forms.

The creation of these special areas is having a positive impact on fauna. Studies by PLDC indicate that the sensitive littoral fauna is quickly establishing. Additionally, the bird life appears to be increasing in both numbers and in variety.

Sydney International Regatta Centre

In 1986, the Government requested PLDC to investigate options for the inclusion of an international standard rowing and canoeing course as part of the overall Scheme development. PLDC presented four options to the Government, each with different completion dates and different costs. The Government selected the option which was completed the earliest as the option for detailed negotiation. The option was the most expensive of the four, but still represented less than a quarter of the cost of developing a similar facility at Homebush Bay.

In 1989, the Government and PLDC entered into a subsidiary agreement under the main Deed for the construction of the course. The principal components of this arrangement were:

- the Government were to pay for any works over and above what PLDC were committed to undertake,
- the Government were to purchase an additional 52 hectares of land for the course,
- PLDC would quarry the additional land paying a royalty on the raw feed extracted,
- PLDC would be project managers for the works,
- Works were to be undertaken in accordance with a cost estimate provided in the Deed,
- Works would commence in December 1990, and
- PLDC would make its best endeavours to complete the works before June 30, 1995

Commitments were made to construct the course well before Sydney had made its decision to lodge a bid for the 2000 Olympics. The site and the works played a significant role in the bid process. In the initial stages, there were several major design issues which needed to be resolved. These issues were raised and discussed with the international bodies controlling rowing and canoeing. Both these bodies willingly provided assistance and have continued to play a significant role in the development of the facility. This early involvement from these organisations put the course into the international arena well before the bid process had commenced. Following the success of the bid, the international bodies have continued their involvement and have regularly provided technical assistance, as and when required.

PLDC met its commitments under the subsidiary Deed, handing over access to the land and lakes on July 3, 1995. The works under the Deed were completed on time and significantly under budget. The Government is currently fitting out the course for use in early March 1996.

The course is set in 200 hectares of rehabilitated lands and lakes, which represents about 10% of the total Scheme area. It contains 80 hectares of lakes, surrounded by 120 hectares of land specially designed for regatta management.

The course is 2,300 metres long, 170 metres wide and has a minimum depth of 4.5 metres. There are nine 13.5 metres lanes set up for the rowing configuration, which can be modified

for the canoeing configuration which requires nine, 9 metre lanes. The course is linked to another lake which will be used as a warm up/warm down area by the competitors.

In designing the course, the key criterion was to ensure that the course was fair across all lanes. Special attention was given to the foreshore treatment to avoid wave reflections interfering with the outside lanes. Wind tunnel testing was undertaken to ensure that wind effects were evenly distributed across all lanes. These tests did show up some anomalies caused by the landforms. These were amended during the final construction stages. The wind tunnel testing also highlighted the benefits of establishing an effective windbreak around the course. On an annual basis, there would be more "rowable" days with the windbreak. The course is now surrounded by 5 rows of irrigated trees with a variety of canopy heights, to give a vertical foliage cover from ground level through to 30 metres height.

The care taken in the early planning stages and the early involvement of the international bodies in the design process has certainly borne results. The course is now being described a the world's best and it is certainly attracting a great deal of attention from both sports. It is having a major impact on the local community by way of creating business opportunities and involvement in the sports. Alternative uses such as triathalon events and major public events are currently being planned for the area.

The national titles for both rowing and canoeing will be held at the SIRC in early March. These major events will test the facility ability to cater for major events. The NSW Rowing Association is planning on 3,000 athletes competing over the six days, with crowds up to 15,000 to 20,000 on the final days. This is distinctly different from the Olympic mode where only 660 athletes will compete and crowds to 30,000 are expected.

Progress to Date

Since PLDC commenced operations in 1980, more than 70 million tonnes of sand and gravel have been extracted from the site. More than 30 million cubic metres of overburden have been removed and placed to create a variety of landforms. Over 40,000 trees have been established in rehabilitated areas. Approximately, half the area has been subjected to quarrying and rehabilitation works.

Recent detailed geological investigations suggests that there is approximately 80 million tonnes of sand and gravel remaining. At the current level of demand, there should be sufficient resources to last until about 2010 or 2011.

Several implications arise from these investigations:

> Firstly, the Scheme's quarry life has been more precisely defined. This gives adequate notice to the Government that an alternative source of supply needs to be investigated now, to ensure a continuous supply of construction material is available for the Sydney market as Scheme resources deplete. This matter has been signalled to the Government.

Secondly, it gives PLDC the knowledge to better plan its operations. Current operations are becoming less efficient as the haul distances from the working pits to the processing plants increase. There are opportunities to review current management and operating practices to make the system more efficient. Major feasibility studies have commenced to address these matters.

Thirdly, these investigations highlighted some geological anomalies in the formation. These anomalies are generally old creek channels which have cut through the resource generally defining areas where there is little or no raw feed. These features were rare in the southern area of the Scheme where previous extraction has taken place. This will require a major review of the current scheme design to ensure that nil raw feed areas are incorporated into the final landforms.

These last two issues signal changes to PLDC's current direction and will need to be resolved in the near future to ensure development of the Scheme continues at a level of excellence.

Towards 2000 and Beyond

The timing of the Olympics provides a recognisable focus for the Scheme, but it should not be the principal focus as there are many opportunities within the Scheme that lie outside the Olympics. There is little doubt that the Olympics will have a major impact on the Scheme and the opportunities which will evolve from the Scheme. It is important that foundations are created to capitalise on the additional opportunities which will be provided by the Olympics. Some issues are:

Management

The Deed requires the Government to manage areas handed over by PLDC. Arrangements are in place for the Olympic Coordination Authority to manage the Sydney International Regatta Centre. An on-site venue manager has been appointed and the OCA is moving toward taking full responsibility for the care control and management of the Centre. The OCA's focus is delivering a venue for September 2000. It will also manage the site for sports development.

This management arrangement is too narrow to accommodate other issues related to the Scheme. The Government is currently establishing the Penrith Lakes Trust which will be ultimately responsible for the ongoing management of the Scheme. The SIRC will be handed over to the Trust after the Olympics.

The Trust is being established under the National Parks & Wildlife Act. The Trust will need a different direction to the traditional State Recreation Area management, as there are different issues and it is a much more complex system. Management costs could reach in the order of $10 million per annum depending on facilities provided and usage. The Trust must explore commercial avenues to meet these costs. Commercial opportunities will be available, however, the Trust must be structured to capitalise on these opportunities.

Environment
Development of the Scheme is being undertaken in accordance with the principles and standards provided in the Deed. Since the original drafting of the Deed, many topical issues have crystallised. The question of biodiversity is a real issue and needs to be considered in the light of environmental opportunities being created within the Scheme.

In regard to flora and fauna assets, the current Scheme area could be regarded as being highly degraded. Two hundred years of intense agricultural activity has all but removed any signs of native flora and fauna. Current quarrying activities can be regarded as a transitional land use with the completed rehabilitated Scheme being the final land use for the area. PLDC current prescriptive form of rehabilitation will no doubt lead to a visually pleasing environment, but it will not have a diverse ecosystem, primarily because of the uniformity in landforms, tree planting and the like. Opportunity is available to create a variety of ecosystems which will complement the complex riverine ecology and to create habitats for special fauna. The complex question of diversity within the gene pool could also be addressed.

PLDC will be focussing on biodiversity and gene pool issues in respect to both the terrestrial and aquatic environments. It is likely that organisations such as the Australian Museum, the Royal Botanic Gardens and Taronga Zoo will provide directions in this area.

Urban Development
The development of the urban lands within the Scheme is a key component to its overall success. Preliminary planning has been undertaken, with the first land sales likely to occur in either 2000 or 2002 depending on the outcome of PLDC's operational review.
The urban development will be unique. Provided it is planned and marketed properly, it has the potential to become a significant asset in the Sydney metropolitan area. It will have water front land, be a component part of a recreational based development and be complemented by a pleasing environment. Traditional approaches to this development should be questioned. Land titles, for example, may be best kept in the form of community title rather than Torrens Title to facilitate total Scheme management. Independent total water cycle management is a possibility as an alternative to service supply from Sydney Water. The multitude of these issues need to be addressed and compared to market acceptance before major commitments are made.

PLDC will finalise its urban development strategy and commence its implementation by 2000.

Water Management:
Development of the Scheme is predicated upon water supply being available from the Nepean River during medium to high flow periods. Water management arrangements in the Hawkesbury Nepean Catchment is currently under review. It is likely that such a review will establish environmental flow requirements for the river system as well as controls being placed upon extractors to ensure that such flow requirements are maintained. The original water studies undertaken for the RES recognised environmental requirements and the Scheme was designed upon the restriction that pumping would only be permissible in

medium to high flow periods. It is likely that the review will more precisely quantify the flow requirements, and any impact to Scheme water management cannot be assessed until such a flow has been determined.

The Scheme has been designed to fit into the river system. There is enough flexibility in the design to deliver favourable outcomes for both the Scheme and the catchment. Recently, a creek system which drains a 1000 hectare urbanised catchment was diverted into the Scheme. Previous plans provided for this creek to be diverted direct to the Nepean River. Benefits of the new arrangement include:

- wiser use of an available resource,
- less pollutant load entering the river,
- less reliance of the Scheme on the river for supply.

Structural changes were required within the Scheme to ensure appropriate water quality in the lakes. Additional works will be required in the upper catchment to minimise nutrient loadings to the lakes. Arrangements are being negotiated with Penrith City Council to implement desirable outcomes from the upper catchment.

Water management opportunities will be a major issue for the Scheme, PLDC and the Government.

Concluding Remarks

The Scheme is unique. PLDC's shareholders can continue their core business while accommodating community use of facilities provided as a by product of the business. Sound planning practices in the formative years of development have layed the foundations for a first class development. Key to the success of the Scheme is a ready willingness of both industry and the government to work toward common goals. It will be up to these sectors to continue to capitalise on the opportunities to bring them to fruition.