LEICHHARDT PARK AQUATIC CENTRE

CO-GENERATION PLANT - CEEP 1240

FINAL REPORT

AUGUST 2013

FUNDING AGREEMENT IN RELATION TO THE COMMUNITY EFFICIENCY PROGRAM FUNDED BY THE DEPARTMENT OF RESOURCES, ENERGY AND TOURISM
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1. Executive Summary

Leichhardt Council has just completed a major infrastructure and energy efficiency project at the Leichhardt Park Aquatic Centre. The works involved the replacement of the existing electric heat pumps servicing the outdoor pools and installing a cogeneration plant and the construction of a plant room. Other works included replacing the existing heat pumps for indoor program pool and upgrading the air handling unit. Cogeneration is a far cleaner and more efficient use of energy compared to the current approach of utilising electric heat pumps in that it produces fewer greenhouse gas emissions and lower operating costs.

An application for grant funding for this project was made under the Community, Energy Efficiency Program (CEEP) which would be funded by the Department of Resources, Energy and Tourism. The CEEP is a grant program that provides co-funding to local governing bodies and non-profit community organisations to implement projects that deliver a range of energy efficiency measures in council and community owned buildings, facilities and sites. Leichhardt Council was successful in obtaining funding to the amount of $459,844.

Construction commenced in August 2012 and was completed in April 2013. On the 11 June 2013 the new cogeneration plant was officially opened by Anthony Albanese MP, Federal Minister for Grayndler and Darcy Byrne – Mayor of Leichhardt.

This report details the implementation of the project and evaluates and discusses the outcomes which subsequently satisfies Milestone 6 of the CEEP Funding Agreement.

2. Introduction


The Energy Management Plan 2011 included energy audits and upgrade analyses for the top 10 energy consuming Council sites and provided recommendations to reduce energy consumption and associated greenhouse gas emissions.

Leichhardt Park Aquatic Centre (LPAC) is Leichhardt Council's largest energy consuming asset, consuming 2,379MWh of electricity in the 2010-11 financial year. Cundall recommended replacing the LPAC’s existing electrically driven heat pumps with a cogeneration system to improve energy efficiency and reduce annual energy costs and greenhouse gas emissions.
Cogeneration is the simultaneous production of electricity and the exploitation of waste heat from the generation process to supply heating needs. By producing lower carbon electricity which can be used to service the Leichhardt Park Aquatic Centre and displacing the electricity needed to heat the pools with zero carbon waste heat, Leichhardt Council can achieve significant emissions reductions. It is estimated that the cogeneration system will reduce greenhouse gas emissions by 1,270 tonnes of carbon dioxide per annum. This equates to approximately 35% of stationary energy emissions from the entire Leichhardt Council operations (ie from ALL council owned sites).

3. Community Energy Efficiency Program

The Community Energy Efficiency Program (CEEP) is a competitive grant program that provides co-funding to local governing bodies and non-profit community organisations to implement projects that deliver a range of energy efficiency measures in council and community owned buildings, facilities and sites.

The objectives of this program are to -

- support a range of local Councils and community organisations increase energy efficiency of different types of non-residential council and community use buildings, facilities, and
- Demonstrate and encourage the adoption of improved energy management practices within Councils, organisations and the broader community.

Leichhardt Council submitted an application for grant funding for the cogeneration works at Leichhardt Park Aquatic Centre and was subsequently successful to the amount of $459,844.

4. Scope of Works

The outdoor pool heating was previously served by three 240kWe electric heat pumps which were nearing the end of their useful life. Council’s proposal was to replace the two heat pumps servicing the 50m pool, diving pool and mushroom pool with an efficient cogeneration system. In addition, the heat pump servicing the indoor enclosed pools (Learn to Swim & Spa Pool) were replaced with a 240kW electric heat pump providing upgraded water heating requirements for the indoor pools and an upgrade of the air handling system for the enclosure.

The cogeneration plant comprises the following components:

- Two 30kWe micro turbines, capable of providing a combined 120kW of heat output.
- Two high efficiency boilers each rated at 350kW.
- A new plant room of 150m2 for housing the micro turbines, boilers, heat exchangers and other plant equipment.
The type of cogeneration unit that was installed is a micro-turbine arrangement. Consultants Steensen Varming designed the cogeneration system using micro-turbines due to the units being a lot smaller and they have a higher power density (with respect to footprint and weight), extremely low emissions and few moving parts. Additional benefits include higher operational efficiencies with minimal turn down and reduced peak tariff electrical usage.

The improved efficiency of the cogeneration plant, and associated high efficiency boilers and upgraded heating and air requirements for the indoor pools, as well as the switch from electricity to gas will result in reduced annual energy costs. Annual operational costs have been predicted to be $119,581/pa the payback period for this work is estimated at 9.7 years (see section 5.0 which details the calculation for the payback period.

The construction program proposed was to ensure that the learn to swim program was not interrupted so the works on the indoor pool was planned during the summer school holiday period. Similarly, the outdoor pool heating system were to remain operational with the changeover from the existing heat pumps to the cogeneration system scheduled to occur only during the summer months (December to February). The design also called for the relocation of one existing heat pump servicing the 50m and diving pool to allow the building construction for the cogeneration plant room to take place.

5. Tenders

Public tenders were invited for the upgrading of the swimming pool heating via the construction of a cogeneration plant and the construction of a plant room. Following extensive analysis of the tenders received it was recommended that the submission by M+W Group Pty Ltd be approved to the amount of $1,225,639. At Councils July 2012 meeting this recommendation was endorsed.

6. Budget

Council negotiated a revised tender of $1,225,639 (excl GST) for the above scope of works. It was recommended that an additional budget be allocated for gas supply works, project management and contingencies bringing the total funding required to $1,606,000. A further $306,000 is proposed to be funded from Environment Sustainability Fund and $100,000 from the 2012/13 WASIP program. In addition, $459,844 was grant funded under the CEEP.
Proposed Budget (Costs)

<table>
<thead>
<tr>
<th></th>
<th>Dollars (excluding GST)</th>
</tr>
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<tbody>
<tr>
<td>Capital Cost - Adjusted Tender</td>
<td>$1,225,639</td>
</tr>
<tr>
<td>Consultants &amp; tendering costs</td>
<td>$180,330</td>
</tr>
<tr>
<td>Education</td>
<td>$20,000</td>
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<tr>
<td>Gas supply (provisional sum)</td>
<td>$80,000 (allowance)</td>
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<tr>
<td>Site supervision – project management</td>
<td>$60,000</td>
</tr>
<tr>
<td>Other works/contingencies budget</td>
<td>$60,000 (5% only)</td>
</tr>
<tr>
<td>Total (approximately)</td>
<td>$1,606,000</td>
</tr>
</tbody>
</table>

7. **Cost Benefit Analysis**

During the feasibility and design stage a life cycle and cost benefit analysis was undertaken by the design consultants to replacing firstly, the existing heats with like for like and secondly by installing a cogeneration plant. The design consultant undertook a Life Cycle Cost for each option. This analysis demonstrated that the installation of a cogeneration plant had long term cost savings in addition to environmental benefits.

The same escalation rate was used below across both options at 5% (which now would be much higher due to the carbon tax however this has not been adjusted for consistency sake. (In reality the carbon tax means the payback period would be reduced significantly).

<table>
<thead>
<tr>
<th></th>
<th>Base Case¹</th>
<th>Tender²</th>
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</thead>
<tbody>
<tr>
<td>Capital Cost ($)</td>
<td>$</td>
<td>$1,606,000</td>
</tr>
<tr>
<td>Net Annual Operational Costs ($/pa)</td>
<td>$198,397</td>
<td>$119,581</td>
</tr>
<tr>
<td>Payback Period (Years)</td>
<td>n/a</td>
<td>9.7</td>
</tr>
<tr>
<td>Carbon Savings (Tonnes/pa)</td>
<td>n/a</td>
<td>1,270</td>
</tr>
</tbody>
</table>

Annual Maintenance is now included in the Operational costs
For comparison purposes the base case tender cost has been adjusted for tender revisions, and an allowance made for preliminaries, profit and attendance.
Tender costs include extraneous costs, consultants, contingencies and project management costs.
1. The initial base case was to replace the existing heat pumps like for like. The cost for this work was estimated at $410,000 in the concept design report. This was later revised during the detailed design to $431,800 excluding consultants and GST.
2. The revised Cogen proposal cost excluding GST and consultants is $1,225,639 Capital cost

Graph of both options with 9.7 year payback period.

8. Activities

1.1 Demolition of plant room, removal of outdoor heat pump and gas extension.

The project involved the removal, relocation and recommissioning of one of the existing heat pumps servicing the outdoor pools where the proposed plant room was to be constructed. The heat pump was relocated to the rear lane for the duration of the building works.

The building program revealed construction commencing before the summer months which required a review of the heat load requirements for the 50m pool and diving pool. Council commissioned further early testing of the existing heat pumps to determine the capacity for temporary relocation. Investigations determined that it was feasible to relocate the removed heat pump to the roadway adjacent to the site for the 6 month period of the building works. In this regard M+W Group Pty Ltd also provided Council with temporary hire costs for heat pumps if relocating the removed heat pump is not possible.

The LPAC site within Leichhardt Park currently has no gas supply. Investigations revealed the nearest gas main is located in Glover Street near the corner of Chapel Street some 360m from the proposed plant room. Council separately ordered the gas supply connection from Jemena Pty Ltd. Negotiations proceeded with Jemena to extend the mains into the park with an easement at no additional capital cost to Council. Provided Council signs off on the purchase of the cogen plant and the construction for the project during the next month then Jemena can complete their gas connections works prior to December 2012, when it would be required under the builders program. A budget of $80,000 is provisionally included above for the gas service extension works should Council be required to install a private service line.
1.2/1.3 **Cogeneration purchase and installation and plant room construction for outdoor pool**

The design allowed for the gas meter (cogeneration unit will be driven by gas) to be installed on a 450mm wide footpath adjacent to the entrance to the plant room, however the actual gas meter was larger than expected. Jemena advised that there needed to be a 900mm clearance on each side of the gas meter, therefore a new location needed to be found.

As a consequence, the only viable space that could fit the gas meter and would be approved by Jemena, was an area at the front of the building. The stair case needed to be redesigned and realigned as a result. The gas line also needed to be extended to the new area.

There was a 2 and 1/2 week delay to the project, in determining a) Costs involved and who was to pay for this additional work, b) Obtaining the approvals from Jemena for the new gas meter location, c) redesigning the staircase.

1.4/1.5/1.6 **Boiler purchase and installation (indoor and outdoor pool)/ Cogeneration and boiler commissioning and handover**

Two micro turbine turbines with heat recovery and two boilers will meet the heating demands, with the boilers rated at 60% load. The plant will be staged as such that heat from the micro turbines are used preferentially to the boilers. The heating water system is arranged in a primary and secondary configuration, with all heating planting parallel on the primary. There is one secondary circuit feeding a heat exchanger that is coupled to the pool water. In essence this heating plant replaced the existing heat pump and connects into the existing PVC pipework.

1.9/1.10 **Installation and connection of Building Management System (BMS) indoor and outdoor pool**

The BMCS will control the plant to operate and to maintain conditions in the aquatic centre using hot water generators and electric chiller. The BMCS will also enable two micro turbines which will supply electricity to the site and will be capable of providing a combined 120kW of heat output.

The BMCS will enable the cogeneration plant system via an adjustable time schedule, initially set to operate from 7am to 10pm. The heating water for the main plant by two cogeneration units (CHP) which are programmed to operate all hours outside the electricity-off peak hours due to the electricity base peak load exceeding both the CHP units total the electrical output.

The AHU units for the indoor pool area will be controlled via a BMS time schedule, when the time schedule is turned on the BMS will energise an interface relay in the mechanical switchboard to start the supply air fan (AHU-01) and return air fan (AHU-02) and the Variable Speed Drive VSD speed will be set to run.
1.11/1.12 Purchase and installation of heat pump (indoor pool)

The design consultants additionally recommended a modification to the layout of the proposed indoor pool plant room to better accommodate the future works filtration proposed for the indoor & spa pools. This will also facilitate an improved work program for the current works. The recommended modification is to relocate the proposed heat pump and the air handling unit for the indoor pool to the rear of the existing plant room and additionally construct a slab to support the relocated plant. The existing heat pump can continue to operate during installation of the proposed heat pump prior to the December school holidays thereby reducing the potential impact on the Learn to swim operations. It was agreed that Steensen Varming would provide M+W Group Pty Ltd a narrative of the proposed modifications to indoor pool plant room layout in order for M+W Group Pty Ltd to propose a revised program.

1.13/1.14/ 1.15/1.16 Purchase and installation of air handling unit (indoor pool)/ Purchase and installation of chiller (indoor pool)

Heating requirements will be met through latent energy dehumidification of exhaust air via a chiller operating as a heat pump. Two air handling units will be provided to serve the indoor pool room. Supply and return air will be provided to the indoor pools via the existing underground tunnels. The supply air unit will be located when the existing built up air handler is, and the relief air unit will be located outside where the existing air source heat pump is located.

The supply air will have a heating coil to sufficiently heat the air. The low temperature heating water will be supplied by condenser water from a water cooled heat pump chiller. A cooling/dehumidification coil located in the relief air handling unit will act to load the chiller. The net effect is energy transfer from the from the exhaust air stream back to the incoming air and pool water via the chillers condenser water circuit. Net addition of heat into the pool water and air to account for the fabric heat losses will occur by cooling the exhaust air below temperature of the incoming outdoor air (which is then magnified by the heat rejection from the chiller. Cooling capacity is also provided by the system to some extent by returning the cool air off AHU 2 back into the supply system.

9 Communication

Communication was an important component of the project with several key audiences were targeted. LPAC staff, LPAC users, Leichhardt Council staff and the general community of the LGA. Examples of how the works were communicated are listed below:

- Promotional newsletters were prepared and distributed to the LPAC patrons on the project objectives and benefits.
• LPAC facility managers and staff given guided tour of site during construction.

• Japanese Councillors visiting Australia given tour of the site in Nov 2012.

A pamphlet has also been manufactured and distributed to the community detailing what works had occurred in the aquatic centre and describing the benefits of Council switching to cogeneration.

In addition to the above promotional activities, an official opening of the new cogeneration plant occurred on the 11 June 2013. Darcy Byrne – Mayor of Leichhardt and Hon Anthony Albanese MP attended the opening with local media and residents in attendance.

A number of key messages were communicated throughout the media and the community and can be summarised below-

• Leichhardt Council is committed to reducing greenhouse gas emissions and minimising its impact on the environment.

• The cogeneration plant will achieve significant reductions in greenhouse gas emissions and result in significant cost savings.

• Leichhardt Council is a leader in environmental improvement and greenhouse gas mitigation, and can provide advice to residents regarding energy efficiency and sustainability.

• The project is in partnership with the Federal Government.

10. CEEP Objectives

The objectives of the Community Energy Efficiency Program are to:

• support a range of local councils and community organisations increase the energy efficiency of different types of non-residential council and community-use buildings, facilities and lighting; and

• demonstrate and encourage the adoption of improved energy management practices within councils, organisations and the broader community.

The Leichhardt Park Aquatic Centre Cogeneration project was a stand alone but organisationally was part of a broader strategy to reduce Council's energy consumption and greenhouse gas emissions. The project was identified by qualified energy auditors as having the greatest potential across any council facility to achieve energy savings, greenhouse gas emissions reduction and set an example to the community. The project holds the greatest potential for council to set a realistic but significant carbon reduction target.

Leichhardt Council is a local government leader in environmental initiatives with a highly interested and engaged community as reflected by social indicators such as participation in environmental interest and advocacy groups.
In December 2011 the Climate Change Taskforce committee recommended to Council that it seek to pursue the Leichhardt Park Aquatic Centre Cogeneration as a priority and as part of a suite of energy savings initiatives arising from energy audits of council sites. People living, studying and working in the Leichhardt LGA tend to be passionate about the area and active in key issues that affect them.

The construction of the cogeneration plant demonstrates that Council is a leading Council that has taken action and leadership in combating carbon emissions. The objectives from the CEEP program have been achieved and met.

11. **Project Evaluation and Reporting**

The success of the project will be measured in terms of-

- Ongoing abatement of greenhouse gas emissions from LPAC operations
- Pool water heating services that meet or exceed the reliability of the current service
- Cost savings to Leichhardt Council over the lifetime of the project
- Reliability of the new HVAC system for the indoor pools

Design consultants Steensen Varming have specified a comprehensive monitoring system for the logging and trending the ongoing systems performance of the plant. They will also be involved in the post-construction stage and monitoring/ fine-tuning of the system.

Leichhardt Council has also purchased and implemented an online Carbon Management Tool that allows Council to monitor and report on energy use and subsequent emissions from all its properties. This tool has an added functionality, which allows Council to link energy efficiency projects/measures to selected properties. When linking these projects/measures, the proposed reduction in energy use or greenhouse gas emissions can be included. This allows the user to monitor if energy efficient projects/measures are achieving the proposed outcomes and to undertake action when energy use or greenhouse gas emissions are higher than proposed.

Leichhardt Park Aquatic Centre (LPAC) has been included in the Carbon Management Tool. Leichhardt Council will link the installation of a cogeneration system to this property, including the proposed reduction in energy use and greenhouse gas emissions. The energy use data is automatically uploaded to the system on a monthly basis, which allows Council to undertake detailed analysis and verify that the proposed energy reduction is met. Whenever higher energy use than proposed is recorded, a notification will be sent to the system manager who can then undertake the required actions to address this higher energy use.

As well as being able to undertake action when required, the Carbon Management System will allow Council to monitor and report on variations in energy use due to seasonal changes or extreme weather events and will allow Council to fine tune the cogeneration system accordingly.
Evaluation reports based on the data that is gathered through the abovementioned monitoring process, will then be written to monitor and evaluate the success of the project.

Because the Carbon Management System tracks the energy use of all of Council’s properties, the impact of the project on Council’s total energy use and greenhouse gas emissions can be monitored and evaluated. This will allow Council to communicate the outcomes of the project to the wider community and report on the overall success.

12. Outcomes and Evaluation

Leichhardt Council is proud to report that the most important carbon reduction project, the cogeneration plant at Leichhardt Council is now complete. The cogeneration plant began operation in April 2013 and Council has already seen a significant decrease in the electricity consumption at the centre following the cogeneration plant being connected to gas. The energy and cost savings calculated in the feasibility study will not be known though for a period of 12 months from the date of commissioning.

The overall success of the project can be identified in three parts. 1.) Date of completion, 2.) Cost of project, 3.) Energy and Cost Savings.

Date of completion
The construction program was to ensure that the Learn to Swim program was not interrupted, therefore the works occurred during the 4 week school holiday period in January 2013. Commissioning together with the indoor pool being heated were completed prior to the start of the school holiday program at the end of January 2013. The contract was prepared to ensure that these critical dates were a significant aspect of the works and that any delay would incur costs to Council. All works were completed on time and the Indoor School Program commenced as advertised.

Similarly, the outdoor pool heating remained operational with the change over from the existing heat pumps to the cogeneration plant. These works occurred as programmed.

Cost of Project
Council can report that the project was completed on budget. $1,606,000 was allocated towards this project, and Council can report that there was $5,000 in savings. For a project of this magnitude and significance, this was a great achievement.

Energy and Cost Savings
It has been calculated during the detail design phase of the project, the installation of a cogeneration plant would reduce emissions by 1270 tonnes annually. In addition, Council will save approximately $79,000 per year in operation costs. It was also estimated that it would take Council nearly 10 years to pay for the project when compared with the base case scenario. Council’s recent electricity bill provides an indication in the reduction in electricity the centre has sourced following the transfer over to gas. It will not be until mid 2014 when Council collate the necessary statistics from the
cogeneration plant to determine whether there has been carbon savings and costs savings.

Lessons learned from implementing the project
There have been a number of lessons learned following the implementation of the project. The first being ensuring that the consultants project brief fully identifies and describes what Council wants to achieve out of the project. This ensures that the design is able to meet the objectives. The reliability of the design is dependent on the data given to the consultant. At the Aquatic Centre it was difficult to obtain up to date civil, electrical and hydraulic plans of the pool. In addition, information such as previous electrical bills weren’t easily accessible. This data was critical in the life cycle analysis of the proposal, therefore many hours was spent gathering all this data.

Another lesson learnt was to engage a time analysis consultant to forensically analyse the project plan of the preferred contractor to ensure that the milestones were achievable. From past experience, projects are delayed because the contractors promise what they cannot deliver. In this instance, the timing of the project was critical. Any delay to the school holiday swimming program would result in a $50,000 per week loss to Council, therefore engaging an expert to review the project plan was a main reason for success. The project plan was adjusted numerous times before approval was granted. In particular the lead times on all the equipment, as they were mostly shipped from Europe.

Finally, the last lesson learnt was to ensure that the main contractor engaged was experienced and had delivered similar projects previously. The contractor’s quotation was not the least expensive, however they had the necessary skills and deliver the project on time and on budget. Council was also fortunate that the site engineer was professional and experienced.

In conclusion, the success of the project can be attributed to the investigation stage and ensuring that prior to the works commencing, Council was confident that every last factor was investigated prior to the contractor being engaged. The construction stage of the project ended up being the simplest part of the entire works.
## ATTACHMENT A

### Project Energy Efficiency Improvement

<table>
<thead>
<tr>
<th>PROJECT TITLE</th>
<th>Leichhardt Park Aquatic Centre Cogeneration Project</th>
<th>PROJECT ID</th>
<th>CEEP1240</th>
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<tbody>
<tr>
<td>FUNDING RECIPIENT</td>
<td>Leichhardt Municipal Council</td>
<td>DATE</td>
<td>21 January 2013</td>
</tr>
</tbody>
</table>

#### Building, Facility or Site 1

<table>
<thead>
<tr>
<th>Name of Building, Facility or Site 1</th>
<th>Leichhardt Park Aquatic Centre</th>
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<tbody>
<tr>
<td>Location (address)</td>
<td>Mary Street, Lilyfield NSW 2040</td>
</tr>
<tr>
<td>Type of building, facility or site</td>
<td>Aquatic Centre- outdoor 50m pool, outdoor diving pool, toddler pool and indoor program pool</td>
</tr>
<tr>
<td>Activity Type and Measure</td>
<td>Installation of cogeneration plant and upgrade of HVAC system</td>
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</tbody>
</table>

#### Energy Efficiency Estimate

**Method**

Energy modelling was been undertaken in order to quantify the operational costs and associated emissions. Temperature differential (between the pool ambient conditions) profiles were modelled for every hour of the day, for a typical day of the month of the year in order to establish the anticipated heating demand profile. These measurements were conducted by an independent third party assessor.

<table>
<thead>
<tr>
<th>Baseline Energy Usage</th>
<th>5,623,179 MJ per annum</th>
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<tbody>
<tr>
<td></td>
<td>3,878 MJ/M² per annum</td>
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</table>

<table>
<thead>
<tr>
<th>Baseline Energy Efficiency</th>
<th>13,484,829 MJ per annum (proposed energy usage)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>9,299 MJ/M² per annum</td>
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</table>

<table>
<thead>
<tr>
<th>Energy Efficiency Improvement</th>
<th>7,860,985 MJ per annum (difference)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>5,421 MJ/M² per annum</td>
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</table>

#### Reporting Data (Measuring Energy Efficiency and Additional Data)

- 50m outdoor heated pool with 930m² surface area and 1307m³ volume.
- Diving heated pool with 280m² surface area and 1129m³ volume.
- Outdoor toddler pool with 180m² surface area and 96m³ volume.
- Indoor bubble pool with 62m² surface area and 48m³ volume.
- **TOTAL AREA- 1,450m²**

<table>
<thead>
<tr>
<th>Cost of Activity</th>
<th>$1,606,000</th>
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<tbody>
<tr>
<td>Estimated Cost Savings</td>
<td>$78,816 per annum</td>
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<tr>
<td></td>
<td>1,270 (Tonnes/pa) carbon savings</td>
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ATTACHMENT B - PHOTOS

Main Plant Building
Inside Main Plant Room showing Cogeneration Unit
Cutting of ribbon