28. Te Pou Toetoe: Linwood Pool Alternative Mechanical HVAC Solution

Reference / Te Tohutoro: 20/26644
Presenter(s) / Te kaipāhō: Brent Smith - Principal Advisor Citizens and Community

Confidentiality

<table>
<thead>
<tr>
<th>Section under the Act:</th>
<th>The public conduct of the part of the meeting would be likely to result in the disclosure of information for which good reason for withholding exists under section 7.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-clause and Reason:</td>
<td>s7(2)(b)(ii) - The withholding of the information is necessary to protect information where the making available of the information would be likely unreasonably to prejudice the commercial position of the person who supplied or who is the subject of the information.</td>
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<td>s7(2)(h) - The withholding of the information is necessary to enable the local authority to carry out, without prejudice or disadvantage, commercial activities.</td>
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<tr>
<td></td>
<td>s7(2)(i) - The withholding of the information is necessary to enable the local authority to carry on, without prejudice or disadvantage, negotiations (including commercial and industrial negotiations).</td>
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</tbody>
</table>

Plain English Reason: The report relates to a live procurement exercise and covers commercially sensitive information.

Report can be released: On execution of the construction contract within first quarter 2020

1. Purpose of Report / Te Pūtake Pūrongo

1.1 To advise the Finance and Performance Committee of a proposed change to the mechanical HVAC solution for Te Pou Toetoe: Linwood Pool and seek the Committee's approval of the proposed change.

2. Executive Summary / Te Whakarāpopoto Matua

2.1 On the 7 February 2019, the Finance and Performance of the Whole resolved (FPCO/2019/00010) to approve the increase of the Linwood Pool budget to $22,719,750 (an increase of $1.1m over the original mechanical services estimate to enable the integration of a wastewater heat recovery (WWHR) system within the Linwood Pool facility. The funding for this increase was provided through reprioritisation of the 'Recreation and Sport Buildings & Plant R & R Programme' FY21.

2.2 It was noted that this initiative directly aligned with Council’s Strategic Policy of Climate Change Leadership, and this was the basis of support for this option.

2.3 The advantages of the WWHR system were that the electricity required to heat the pools would reduce by an estimated 290,000kWh per annum and provide associated carbon savings of 37 tonnes per annum against the base case. (Attachment A)
Finance and Performance Committee - Public Excluded
30 January 2020

2.4 Requests for Proposals for the construction of Te Pou Toetoe: Linwood Pool were received from shortlisted Contractors mid-October 2019. Prices submitted from all three respondents significantly exceeded the available project budget, with the wastewater heat recovery component of each response also significantly exceeding the budget allowance. Specifically, the price from the ‘Preferred contractor’ for the integration of a WWHR system was approximately $2.4m higher than the original mechanical services estimate.

2.5 Following identification of a ‘Preferred Contractor’, the Project Team have worked with that Contractor to identify alternative options, and have now reached a price position where a recommendation to proceed within the project budget can be made.

2.6 As part of the process with the preferred contractor, alternative sustainable mechanical HVAC systems were explored that could be delivered more cost effectively (for this project). A preferred mechanical HVAC system was identified with a cost $0.9m higher (excluding contingency) than original mechanical services estimate. This alternative delivers electricity savings of 275,000kWh per annum and associated carbon savings of 35 tonnes per annum against the base case. The alternative solutions have been reviewed by Powell Fenwick and a Design Advice Memo issued (Attachment B).

2.7 The preferred mechanical HVAC system offered is reflected in the current price proposal from the preferred contractor. On the basis that this is within the $1.1m additional budget added in February 2019, and offers comparable sustainability credentials and operating costs, it is requested that the Finance and Performance Committee approve that the project implements the alternative mechanical HVAC system.

2.8 To continue with the WWHR system would require a reduction in the approved scope of Te Pou Toetoe: Linwood Pool to remain within budget and/or additional funding secured.

3. Staff Recommendations / Ngā Tūtohu
That the Finance and Performance Committee:

1. Approve the preferred mechanical HVAC system as a replacement to the wastewater heat recovery system for Te Pou Toetoe: Linwood Pool as resolved by the Finance Committee of the Whole on 7 February 2019 (FPCO/2019/00010).

4. Context/Background / Te Horopaki

Issue / Ngā take

4.1 On the 7th February 2019 the Finance and Performance Committee of the Whole resolved (FPCO/2019/00010) to increase the Linwood Pool budget to integrate a wastewater heat recovery system.

4.2 Requests for Proposals for the construction of Te Pou Toetoe: Linwood Pool were received from shortlisted Contractors mid-October 2019. Prices submitted from all three respondents significantly exceeded the available project budget, with the wastewater heat recovery component of each response also significantly exceeding the budget allowance.

4.3 An alternative mechanical HVAC system is now the preferred option however the original resolution is specific to a wastewater heat recovery system, which is no longer the preferred option.

4.4 The full project budget ($22,719,750) is required to deliver the project and the inclusion of the preferred mechanical HVAC system.
Strategic Alignment / Te Rautaki Tīaroaro

4.5 Council’s strategic priorities of meeting the challenge of climate change through every means available and ensuring rates are affordable and sustainable have been considered with respect to the reduction in electricity consumption, associated carbon savings, and maximising the project budget for Te Pou Toetoe: Linwood Pool.

4.6 This report supports the Council’s Long Term Plan (2018 - 2028):

4.6.1 Activity: Facilities, Property & Planning

- Level of Service: 13.4.29 We provide advice and projects that reduce the energy used in Council facilities. - 1.7% reduction year on year energy use

Decision Making Authority / Te Mana Whakatau

4.7 This decision is a delegation to the Finance and Performance Committee.

Previous Decisions / Ngā Whakatau o mua

4.8 On 7 February 2019, the Finance and Performance of the Whole resolved (FPCO/2019/00010) to:

1. Approve the increase of the Linwood Pool budget from $21,641,750 to $22,719,750 (an increase of $1,078,000 to enable the integration of a wastewater heat recovery system within the Linwood Pool facility.

2. Approve the funding of the waste water heat recovery system for the Linwood Pool up to $1,078,000 through reprioritisation of ‘Recreation and Sport Buildings & Plant R & R Programme’ FY21.

3. Request that staff also seek third party funding for wastewater heat recovery system for the Linwood Pool.

4. Note that this initiative directly aligns with Councils Strategic Priority of Climate Change Leadership.

Assessment of Significance and Engagement / Te Aromatawai Whakahirahira

4.9 The decision in this report is of low significance in relation to the Christchurch City Council’s Significance and Engagement Policy.

4.9.1 The level of significance was determined by considering the impact on the environment, the community and costs of utilising the preferred Mechanical HVAC solution instead of the waste water heat recovery system.

4.9.2 The community engagement and consultation outlined in this report reflects the assessment.

5. Options Analysis / Ngā Köwhiringa Tātari

Options Considered / Ngā Köwhiringa Whaiwhakaaro

5.1 The following reasonably practicable options were considered and are assessed in this report:

- Option 1 – Mechanical HVAC system

- Option 2 – Retain the wastewater heat recovery system
Options Descriptions / Ngā Kōwhiringa

5.2 Option 1 (Preferred Option): Mechanical HVAC system.

5.2.1 Option Description: The preferred mechanical HVAC system uses no fossil fuels and uses all electrical based technology with mainly heat pumps used. The proposed solution includes the following features:

- Pool specific Air Change heat recovery heat pumps serving the pool hall air conditioning.
- Air sourced heat pumps serving the pool heating, changing rooms, fresh air preheat for the front of house and domestic hot water.
- VRV air sourced heat pump system serving the front of house offices, meeting rooms and foyer.

5.2.2 Option Advantages

- The capital costs of the preferred mechanical HVAC system is $1,535,072 less than the WWHR system.
- The operating cost savings of the preferred mechanical HVAC system are comparable to those of the WWHR system, with an additional estimated annual operating cost of only $2,500 annually (Attachment B). It would take over 600 years of operational savings to recoup the additional $1,535,072 capital cost.
- The preferred mechanical HVAC system provides electricity savings of 275,000kWh per annum and associated carbon savings of 35 tonnes per annum against the original base case.
- The preferred mechanical HVAC system is reflected in the current price proposal from the preferred contractor and within the project budget. The construction contract can be executed with the preferred contractor immediately.

5.2.3 Option Disadvantages

- The preferred mechanical HVAC system will annually use 15,000kWh more electricity than the WWHR system. This equates to 2.47% of the total annual electricity use of the preferred mechanical HVAC system or an additional operational cost of $2,500 per annum.

5.3 Option 2: Retain the wastewater heat recovery system.

5.3.1 Option Description: The wastewater heat recovery system originally proposed includes the following features:

- Utilises heat from wastewater flowing through the pressure sewer main adjacent to the site as thermal energy.
- Allows the facility to offer electricity savings over conventional air source heat pumps through increased heat pump efficiencies.

5.3.2 Option Advantages

- Minor additional efficiency savings compared to the mechanical HVAC system (will use 15,000kWh less electricity). This equates to an operational cost of $2,500 per annum.
5.3.3 **Option Disadvantages**

- The capital costs of the preferred mechanical HVAC system is $1,535,072 less than the WWHR system. Therefore adopting a WWHR system would require either the project to be de-scoped or for additional budget to be added.
- As the preferred mechanical HVAC system is reflected in the current price proposal from the preferred contractor, a decision to adopt a WWHR would lead to delays in proceeding with the construction contract.

**Analysis Criteria / Ngā Paearu Wetekina**

5.4 The key assessment criteria included the efficient use of resources (electricity), capital costs to implement each system, and operational costs of each system.

6. **Community Views and Preferences / Ngā mariu ā-Hāpori**

6.1 Community feedback has not been sort for this option.

6.2 Based on the operational nature of the decision it is considered that people are unlikely to be affected.

7. **Legal Implications / Ngā Hīraunga ā-Ture**

7.1 There is not a legal context, issue or implication relevant to this decision.

7.2 This report has been reviewed and approved by the Legal Services Unit.

8. **Risks / Ngā tūraru**

8.1 There is a risk associated with this decision that some individuals or groups within the community may not support the change from the waste water heat recovery system.

8.1.1 Residual risk rating: The residual rating of the risk after the below treatment is low.

8.1.2 Planned treatment is to ensure that benefits of the alternative mechanical HVAC solution are communicated.

9. **Next Steps / Ngā mahinga ā-muri**

9.1 Completion of the RFP process for Te Pou Toetoe: Linwood Pool.
### 10. Options Matrix / Te Poukapa

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Option 1 – Mechanical HVAC system</th>
<th>Option 2 - Wastewater Heat Recovery System</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost to Implement</strong></td>
<td>Compared to the original mechanical services base case estimate, the preferred mechanical HVAC system would cost $0.9m (plus contingency) to implement.</td>
<td>Compared to the original mechanical services base case estimate, the wastewater heat recovery system would cost c. $2.4m to implement.</td>
</tr>
<tr>
<td><strong>Financial Implications</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Maintenance/Ongoing       | • The annual electricity usage is estimated for the facility as is $91,000.  
• Maintenance costs of the system are estimated to be materially in-line with the base case estimate.  
• Opex costs were reviewed through the 2017 Aquatics Model and are included in the 2018-28 Long Term Plan. | • The annual electricity usage for the facility is estimated as $88,500.  
• Maintenance costs of the system are estimated to be materially in-line with the base case estimate.  
• Opex costs were reviewed through the 2017 Aquatics Model and are included in the 2018-28 Long Term Plan. |
| Funding Source            | Project Budget of $22,719,750     | c. $1.5m of additional budget would be required. |
| Impact on Rates           | N/A as budgets included in 2018-28 Long Term Plan | N/A as budgets included in 2018-28 Long Term Plan |

#### Efficient use of resources - electricity
- Electrical savings of 275,000kWh per annum against the base case.
- Electrical savings of 290,000kWh per annum against the base case.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Option 1 - Mechanical HVAC system</th>
<th>Option 2 - Wastewater Heat Recovery System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact on Mana Whenua</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Confirmation of Statutory Compliance / Te Whakatūturutanga ā-Ture

Compliance with Statutory Decision-making Requirements (ss 76 - 81 Local Government Act 2002).

(a) This report contains:
   (i) sufficient information about all reasonably practicable options identified and assessed in terms of their advantages and disadvantages; and
   (ii) adequate consideration of the views and preferences of affected and interested persons bearing in mind any proposed or previous community engagement.

(b) The information reflects the level of significance of the matters covered by the report, as determined in accordance with the Council’s significance and engagement policy.

Signatories / Ngā Kaiwaitohu

<table>
<thead>
<tr>
<th>Authors</th>
<th>Nigel Cox - Head of Recreation, Sports &amp; Events</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Kent Summerfield - Senior Project Manager</td>
</tr>
<tr>
<td></td>
<td>Brent Smith - Principal Advisor Citizens &amp; Community</td>
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</tbody>
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<tr>
<th>Approved By</th>
<th>Michael Down - Finance Business Partner</th>
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<tr>
<td></td>
<td>Mary Richardson - General Manager Citizens &amp; Community</td>
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</table>
Linwood Pool

Wastewater Heating Summary Report

Introduction:
All aquatic centers are heavy consumers of heat energy. They typically require large amounts of heat all year around, even in summer, and approximately 80% of the energy consumed by Aquatic Centers is heat. This typically makes these facilities expensive to operate and they carry large environmental footprints in comparison to other types of buildings. Therefore, wherever possible all opportunities to make them more energy efficient should be taken.

Approximately 30% of all the energy consumed by NZ houses is used to generate heat in hot water systems. Everyday this heat is discharged into the associated wastewater network making wastewater an enormous container of thermal energy and an untapped resource available for cities to use by capturing and recycling this thermal energy.

Globally there are thought to be over 1,000 installations using wastewater as a thermal source, including at least 5 installations in Australia. These existing installations also include at least 5 aquatic centres. So, whilst it is a new concept in New Zealand, it is not a new concept globally.

In 2018 a feasibility study was undertaken to assess if wastewater heating was feasible for the Linwood Pool. This study showed that it is feasible and the information provided below is a summary of the findings from that study.

Energy, Financial & Carbon Savings
Benchmarking undertaken by Applied Energy of 20 aquatic centres from NZ, Australia & UK indicates that, on average, aquatic centres consume over 5 times more energy/m² than the average for office/education/retail buildings.

Notable in this benchmarking is the one aquatic centre which we have data for, which is heated from wastewater. This wastewater heating aquatic centre uses approximately 60% less energy/m² than the aquatic centre average. It is acknowledged that the results from just one facility cannot be assumed as being representative for all wastewater heated aquatic centres. However, the results from this one example are impressive and certainly encouraging.

In a similar vein, in 2013 the USA Geothermal Exchange Organization (GEO) commissioned an independent research team from Oklahoma State University and Oak Ridge National Laboratory to evaluate the relative performance of Geothermal Heatpump vs. Air Source VRF heating and cooling systems installed at the American Society of Heating Refrigeration and Air-conditioning Engineers (ASHRAE) International Head-quarters Building in Atlanta. The study showed that over a two-year period—when all variables were accounted for—energy use by the geothermal system averaged 44% less than the VRF system. Given that wastewater also flows at stable and neutral temperatures, similar to geothermal systems, compared to conventional air source heat pumps similar efficiency gains can be expected with a wastewater source heating system.

Based on the above, for the purposes of business case evaluation for wastewater heating of the Linwood Pool, it has been conservatively estimated that compared to conventional air source heat pumps a wastewater heat recovery system will provide a 33% reduction in electrical energy needed for the heating system.
Recovering heat from wastewater will also capture and recycle a significant amount of thermal energy which would otherwise be discarded. This will make both the Linwood Pool Facility and Christchurch City more energy efficient and more sustainable.

It is estimated that installing a wastewater heating system in Linwood Pool results in the following estimated savings:

- **Electricity Savings:** Estimated annual electricity saving through wastewater heat recovery system = 290,000kWh
- **Financial Savings:** Estimated annual energy cost saving through wastewater heat recovery system = $41,500/year.
- **Carbon Savings:** Using the EECA CO2 Calculator, for 290,000kWh electricity savings, there is an associated CO2 saving of 37 tonnes/year. In the future, there may be carbon tax savings available for these CO2 savings being achieved, however given the uncertainty around these carbon tax matters no allowance for these potential financial savings have been assumed.

**Wastewater Heat Recovery Infrastructure and Equipment**

Two wastewater heating technology suppliers were considered as part of the feasibility assessment. These were:

- Veolia/Alfa Laval
- International Wastewater Systems

**'Order of Cost' Capital Estimates**

Below are budget estimates for the infrastructure required for utilising wastewater as the thermal source for the Linwood Pool project. We note that the budget estimates are 'high level' estimates based on limited information available. Our assessment, based on experience with other projects, is that understandably these estimates are therefore conservative (i.e. on the high side).

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wastewater heat exchangers, pumps, screens</td>
<td>$90k</td>
<td>Budget estimate from suppliers for supply, install &amp; commission.</td>
</tr>
<tr>
<td>Reticulation pipework from Pressure Sewer 118 to plantroom &amp; return to sewer</td>
<td>$50k</td>
<td>Assumed 50m PE100 PN16 pipe, trenched @ $1k/m. Rate from GHD Wastewater Optimisation Costs Report.</td>
</tr>
<tr>
<td>Re-injection pumps to push wastewater back into pressure sewer</td>
<td>$25k</td>
<td>Estimate from supplier’s information.</td>
</tr>
<tr>
<td>Heatpump cost reduction through using water source heatpumps.</td>
<td>$(150k)</td>
<td>Estimate from Powell Fenwick.</td>
</tr>
<tr>
<td><strong>Hardware &amp; Infrastructure</strong></td>
<td>$825k</td>
<td></td>
</tr>
<tr>
<td>Design Fees</td>
<td>$50k</td>
<td>Design &amp; Build documentation, Procurement &amp; Construction monitoring.</td>
</tr>
<tr>
<td>WWHR Plantroom Construction</td>
<td>$62.5k</td>
<td>From WTP pre-design estimate</td>
</tr>
<tr>
<td>Total excluding contingency</td>
<td>$937.5k</td>
<td></td>
</tr>
<tr>
<td>Contingency @ 15%</td>
<td>$140.5k</td>
<td></td>
</tr>
<tr>
<td>Total including contingency</td>
<td>$1,078k</td>
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</tr>
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</table>
Alternative Mechanical HVAC Option

The following outlines the alternative Mechanical HVAC system offered by Active Refrigeration as part of the Apollo Projects bid. The purpose of the memo is to outline the potential benefits for the alternative system and how this will affect the energy consumption for the new building.

Comparisons have been made to the recently completed Taiora QEII Recreation and Sport Centre, as well as the wastewater heat recovery heating option for the Te Pou Toetoe: Linwood Pool Facility;

Taiora QEII Recreation and Sport Centre was recently audited for the energy consumption for the first years operation by Powell Fenwick. The Energy Use Intensity (EUI) which is a comparative energy measure was assessed to be 1610 kWh/m²/annum of raw energy over the total conditioned floor area. All energy was electrical based with the heating and cooling generated from air sourced heat pumps with the exception of the LPG used in the café.

The wastewater heat recovery heating option has been proposed to utilise the nearby pressure sewer main as a heat source for the facility, with heat being extracted from the wastewater to source the pools and surrounding spaces. This heating option is heat pump based and provides a steady coefficient of performance around 3.7 throughout the year, which is significantly more efficient that typical air source heat pumps available. Although highly efficient, the wastewater heat recovery option incurs significantly larger capital cost to install than initially anticipated.

The Active Refrigeration alternative offer uses no fossil fuels and uses all electrical based technology with mainly air source heat pumps used. The offer includes the following features:

- Pool specific Air Change heat recovery heat pumps serving the pool hall air conditioning.
- Air sourced heat pumps serving the pool heating, changing rooms, fresh air preheat for the front of house and domestic hot water.
- VRV air sourced heat pump system serving the front of house offices, meeting rooms and foyer.

Specific energy savings that will improve the energy performance from the Taiora QEII Recreation and Sport Centre include the following:

- The Air Change heat recovery units utilises a mylar heat exchanger which will recover 70-80% of the energy from the exhaust air stream from the pool hall to preheat the fresh air. This is a significant improvement from the Taiora QEII Recreation and Sport Centre air handling units which utilise a typical plate heat exchanger which will only recovery 50-60% of the energy from the exhaust air stream.
- The Air Change heat recovery units have in-built air sourced heat pumps and use the heat from the exhaust air stream to further recover energy from the exhaust air stream after the mylar heat
exchanger. This increases the overall coefficient of performance of the air sourced heat pumps to around 3.2 compared to the base case of 2.5 based on supplied data at 10°C ambient air temperature.

- The VRV air sourced heat pump system uses refrigerant through the heat pump and to deliver the heat and coolth to the front of house spaces this system will be more efficient than a heat pump generating low temperature hot water at 45°C like at Tairoa QEI Recreation and Sport Centre.

The following table compares the three options from an energy use perspective.

<table>
<thead>
<tr>
<th>Description</th>
<th>Floor Area (m²)</th>
<th>EUI (kWh/m²)</th>
<th>% Heating</th>
<th>Annual Thermal Heating Energy</th>
<th>Annual Prime Heating Energy</th>
<th>Energy Cost ($/kWh)</th>
<th>Annual Heating Energy Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Case</td>
<td>2,200</td>
<td>1,250</td>
<td>80</td>
<td>2,200,000</td>
<td>880,000</td>
<td>0.15</td>
<td>$132,000</td>
</tr>
<tr>
<td>Wastewater Heating</td>
<td>2,200</td>
<td>1,250</td>
<td>80</td>
<td>2,200,000</td>
<td>590,000</td>
<td>0.15</td>
<td>$88,500</td>
</tr>
<tr>
<td>Alternate Option</td>
<td>2,200</td>
<td>1,100</td>
<td>80</td>
<td>2,112,000</td>
<td>605,000</td>
<td>0.15</td>
<td>$91,000</td>
</tr>
</tbody>
</table>

In summary the alternative proposed from Active Refrigeration as part of the Apollo Projects bid will result in a decreased EUI from the Tairoa QEI Recreation and Sport Centre first year’s operational data which we would expect the resultant EUI to be approximately 1200kWh/m²/annum of raw energy over the total conditioned floor area. Te Pou Toetoe: Linwood Pool at approximately 2200m² results in an estimated total raw energy of 2,750,000kWh, which equates to an approximate 22% energy saving. This alternative also provides a more cost effective solution to improve the energy efficiency of the facility.