



**To:** Public Works and Transportation Committee      **Date:** July 3, 2014  
**From:** John Irving, P.Eng. MPA      **File:** 10-6600-10-02/2014-  
 Director, Engineering      Vol 01  
**Re:** **Alexandra District Energy Utility Expansion Phase 3**

**Staff Recommendation**

That:

1. The expansion of the Alexandra District Energy Utility include additional geexchange fields in the West Cambie Neighbourhood Park, with supplemental conventional energy systems for back up, as presented in the report titled "Alexandra District Energy Utility Expansion Phase 3", dated July 3, 2014, from the Director, Engineering, be endorsed; and
  
2. Capital submissions totalling \$12.3M for design, construction and commissioning of the ADEU Phase 3 be submitted for Council's consideration as part of the City's Five Year Financial Plan (2015-2019).

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 Director, Engineering  
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Att. 2

REPORT CONCURRENCE		
<b>ROUTED TO:</b>  Finance Division Parks Services Development Applications	<b>CONCURRENCE</b>  <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<b>CONCURRENCE OF GENERAL MANAGER</b>  
<b>REVIEWED BY STAFF REPORT / AGENDA REVIEW SUBCOMMITTEE</b>	<b>INITIALS:</b> 	<b>APPROVED BY CAO</b> 

## Staff Report

### Origin

At the December 10, 2012, Council meeting, Council supported the Alexandra District Energy Utility (ADEU) the following recommendations:

1. *Authorize staff to incorporate a wholly owned local government corporation including:
  - a. *naming the corporation Lulu Island Energy Company (pending name availability) (LIEC) with the City of Richmond as the sole share holder to own and operate the Alexandra District Energy Utility (ADEU);*
  - b. *authorizing the Chief Administrative Officer and the General Manager, Engineering and Public Works to execute legal agreements and documentation related to the incorporation.**
2. *Authorize staff to explore the merits of external borrowing of up to \$6M to finance phase 3 of the ADEU and report to Council through Committee on the budget impacts to future capital projects.*
3. *Re-classify the District Energy Manager position from Temporary Full Time (TFT) to Regular Full Time (RFT); and*
4. *Approve the creation of a Position Control Complement (PCC) for the District Energy Manager position.*

This report responds to item #2, a referral by Council for staff to explore the merits of external borrowing to finance Phase 3 of the ADEU expansion and its impacts to future capital projects, and includes a recommended plan for the ADEU Phase 3 expansion.

This initiative aligns with Council's Term Goal #8 Sustainability:

*8.1 Continued implementation and significant progress towards achieving the City's Sustainability Framework, and associated targets.*

### Background

Phases 1 and 2 of ADEU were established in partnership with Oris Geo Energy Ltd. The partnering agreement was limited to providing heating and cooling services to Oris Developments' two projects, Alexandra Gate and Remy.

Council subsequently adopted the Alexandra District Energy Utility Bylaw No. 8641 and Amendment Bylaw No. 8688 on January 24, 2011, which expanded the service area to include the western portion of the Alexandra neighbourhood. This gave ADEU the potential to encompass 3100 units and 1.1 million sq. ft. of commercial space at build out over an estimated 10 to 15 year period.

To date, Council approved \$6M of borrowing from the City's Water Utility Reserve to fund the design and construction of ADEU Phases 1 and 2. These funds will be repaid with interest from customer service fees.

ADEU Phases 1 and 2 were commissioned in July 2012; the system currently provides energy to two developments (Mayfair Place and Remy) with over 600 residential units. The third development, Omega by Concord Pacific, is scheduled to be connected in mid 2014. It is estimated that the current ADEU system capacity is adequate to service this development as well. For its first year of operations and in the context of a small customer base, the financial, operational and environmental results show a better than expected performance of the ADEU system.

Lulu Island Energy Company

The Lulu Island Energy Company (LIEC) was established as a wholly-owned corporation of the City for the purposes of managing district energy utilities on the City’s behalf. ADEU is currently not an asset of LIEC. Staff intend to bring forward a report with recommendations to transfer ADEU assets and operations to LIEC within the next year.

**Analysis**

ADEU Expansion Potential

The current system is estimated to be sufficient to service the two existing connected sites, Remy and Mayfair, and the Omega development which is scheduled to be connected in mid 2014. In order to service more buildings, both heating and cooling capacity and associated infrastructure will need to expand. The ADEU concept and design work completed to date identifies the highest return on energy efficiency and capital occurs with higher density development and high demand users.

Based on the most current construction schedules provided by developers, the City anticipates the need to expand ADEU to provide energy services within the next year. The most advanced project is Polygon’s development, Alexandra Court, planned for the first occupancy in the summer of 2015. In addition, more developments, including SmartCentres, are projected to be completed in years 2016 to 2018. Timelines and building sizes are summarized in Table 1 and mapped in Attachment 1.

Table 1: Development Timing in the ADEU Service Area

	<b>Floor Area (ft<sup>2</sup>)</b>	<b>Use</b>	<b>Occupancy Date*</b>
Alexandra Court	515,000	Residential	2015 Q2
Jamatkhana Temple	26,500	Institutional	2015
9500 Cambie	108,000	Residential	2015
Alexandra Gate	194,000	Residential	2015
SmartCentres	286,000	Commercial	2016
Jingon	132,000	Residential	2016
Polygon East	262,000	Residential	2018

\* Note: Occupancy typically occurs over the course of several months after occupancy is issued.

Originally, it was estimated that Phase 3 will include three developments with 560,000 sq.ft. of floor area. The expanded Phase 3 includes seven developments with total of 1,530,000 sq.ft. of

floor area given the pace of development in the neighbourhood. This results in Phase 3 capital funding requirements greater than the originally estimated \$6M. Including seven developments in Phase 3 results in overall greater efficiency, however, it would require capital investments sooner than expected.

### ADEU Expansion Plan

ADEU was established on the concept that all capital and operating costs will be recovered through revenues from user fees. Council adopted an objective to provide end users with annual energy costs that are competitive with conventional system energy costs based on the same level of service. The primary strategy for construction phasing of ADEU is to match service capacity closely with demand at any given stage. In this way, capital expenditures that don't immediately generate revenue are minimized, and payback periods are reduced. Since the existing ADEU and the proposed expansion are located on City owned park land, no land costs have been included in the capital costs.

A load profiling analysis was completed for the expansion of the ADEU system based on the development schedule identified above. The analysis included a review of the following available local energy resources to best meet the project demand:

- open loop geexchange in a West Cambie Neighbourhood Park,
- closed loop geexchange in a West Cambie Neighbourhood Park, south greenway corridor, road right of ways, disturbed area of the Garden City Lands,
- sewer heat recovery from the sewer pump station on Odlin Road,
- solar thermal on the private building roof,
- natural gas fired boilers,
- cooling towers and fluid coolers; and
- air source heat pumps.

The analysis identified the following two viable options for Phase 3 that would supply the majority of energy for the ADEU system expansion, which are presented below for consideration by Council. Other energy technologies may be required to supplement the main energy sources.

#### Option 1 (Not recommended) – Delayed Implementation of Additional Geexchange Field

Under this option, all energy required to service new customers connected up until year 2021 (except large format retail) would be supplied by natural gas fired boilers for space heating and domestic water heating, and cooling towers for space cooling. Large format retail buildings would receive heating and cooling services from air source heat pump system with excess heat delivered to buildings connected to ADEU.

Beginning in 2021 onwards, after the customer base has grown, additional renewable energy sources will be implemented including potentially geexchange fields in the West Cambie Neighbourhood Park and south greenway corridor.

The existing energy centre, located in the West Cambie Neighbourhood Park on Odlin Rd east of Garden City Rd, will be expanded to accommodate all equipment necessary for the full build out of the ADEU system. A preliminary design for the building shows that the total area requirement

will be approximately 350 m<sup>2</sup> in the form of an addition to the existing building. This would approximately double the size of the existing energy centre building, which was designed and constructed to easily accommodate expansion. The addition will also be a taller building, approximately 8 m in height, as it will include cooling towers installed on the roof. The cooling towers will be screened to the maximum extent possible with visual and sound barriers. There will be opportunity to incorporate public art features into these barriers.

It is estimated that with this option, the total estimated greenhouse gas (GHG) emissions reduction by the ADEU system over the 12 years (until full build out) will be approximately 2500 tonnes (equal to 775 cars) with 671 tonnes (equal to 208 cars) reduction per annum at full build out.

This option is not recommended because the projected financial return is almost identical to Option 2 but the estimated GHG emissions reduction over the 12 years is one quarter of that for the Option 2 (Table 2).

### Option 2 (Recommended) – Immediate Implementation of Geoexchange Fields

Under this option, the portion of the energy required to service new customers will be provided by an additional geoexchange field in the West Cambie Neighbourhood Park, with commencement of construction in 2015. This option includes additional natural gas boilers and cooling towers for supplement and back up. Similar to Option 1, large format retail customers would receive heating and cooling from an air source heat pump system with excess heat delivered to buildings connected to ADEU. In 2019, this option includes a potential plan to add an additional geoexchange field in the future south greenway corridor. At this time, additional natural gas boilers and cooling towers for top up and back up will be required.

The existing energy centre, located in the park, will be expanded to accommodate all equipment necessary for the full build out of the ADEU system. A preliminary design for the building shows that the total area requirement will be approximately 350 m<sup>2</sup> in the form of an addition to the existing building. This would approximately double the size of the existing energy centre building, which was designed and constructed to easily accommodate expansion. The addition will also be a taller building, approximately 8 m in height, as it will include cooling towers installed on the roof. The cooling towers will be screened to the maximum extent possible with visual and sound barriers. There will be opportunity to incorporate public art features into these barriers.

This option includes underground wells for the geoexchange field along the eastern edges of the West Cambie Neighbourhood Park. However, once the park design is completed, staff will explore opportunities to expand the geoexchange wells also under the other parts of the park where possible, without compromising the park's functionality.

The potential impacts to the West Cambie Neighbourhood Park and the future South Greenway will be minimized so as to ensure the function and use of them is not compromised. In the neighbourhood park, a few trees may need to be removed for the geoexchange field and several more for the addition to the energy centre. The expansion will be coordinated with the park and greenway designs to ensure good integration within the landscape.

It is estimated that with this approach, the total estimated GHG emissions reduction by the ADEU system over the 12 years (until full build out) will be over 9500 tonnes (equal to 2950 cars) with 671 tonnes (equal to 208 cars) reduction per annum after full build out. There exists the potential to increase these reductions with implementation of additional renewable/waste energy sources such as sewer heat recovery from Odlin Road sewer pump station. The best technology and configuration will be defined through analysis at future expansion phases.

### Business Case<sup>1</sup>

The comparison of the business cases for the two options is summarized in the Table 2 below. Financial calculations for the payback periods are detailed in Attachment 2.

Table 2: Financial Summary

	Business Case as reported to Council Dec 10, 2012	Updated Business Case	
		Option 1 (Delayed implementation of additional geotreatment fields)	Option 2 (Recommended) (Immediate implementation of additional geotreatment fields)
<b>Capital Cost (Phase 3)</b>	N/A	\$11.0M	\$12.3M
<b>Capital Cost (full build-out)</b>	\$24.3M	\$23.3M	\$23.3M
<b>NPV (discounted at 6.0%)</b>	\$1.35M	\$4.82M	\$4.76M
<b>IRR</b>	6.54%	8.2%	8.01%
<b>Payback</b>	21 years	19 years	19 years
<b>Estimated GHG Savings</b>		2500 tonnes over 12 years	9500 tonnes over 12 years

Note: No land costs have been attributed to the costs of the project since it is located on City owned park land or as part of private developments

### Funding

It is estimated that \$12.3 million (inclusive of design, project management and contingency) would be required for ADEU expansion, which will include:

- expansion of the energy centre (to accommodate equipment requirements for the full build out);
- extension of the distribution piping to service new customers south of Odlin Rd;

<sup>1</sup> The projections are based on prospective results based on assumptions about future conditions and courses of action.

- installation of heat pumps or natural gas boiler system to service new large format retail customers, with connection to ADEU such that energy sharing can occur;
- increasing the heating and cooling capacity to service new customers in the north and south loop via geexchange field along the eastern edge of the West Cambie Neighbourhood Park; and
- increasing the heating and cooling capacity to service new customers in the north and south loop via boilers and cooling towers.

This funding will be needed over the next 3-5 years to complete the Phase 3 expansion (see Table 3 below). Funding for this expansion will provide infrastructure to service an additional seven developments and 1,530,000 square feet floor area. Once this expansion is completed, ADEU will be servicing 2,280,000 square feet floor area that represents 65% of the planned serviced floor area. Phase 1 and 2 funding of \$4.8M provided infrastructure to service three developments and 750,000 square feet floor area.

Table 3: Funding Requirement Timing

	<b>Estimated Occupancy Date</b>	<b>Estimated Capital Requirement</b>	
Alexandra Court	2015	\$7.2M	2015
Jamatkhana Temple	2015		
9500 Cambie	2015		
Alexandra Gate	2015		
SmartCentres	2016	\$2.5M	2016
Jingon	2016	\$2.6M	2016-2018
Polygon East	2018		

### Financing Strategy

ADEU was approved on the basis that it would be financially self-sustaining. As a new system, the incremental cost to connect a new customer is high due to the need for new energy generation and distribution facilities. Over time, capital costs on a per building basis will decrease as the same infrastructure can be used to connect new buildings. The City has the option to fund capital costs internally or externally. Over the course of the full build out of ADEU, the City will have numerous decision points for optimizing financing strategies to achieve its objectives.

For the Phase 3 expansion, staff have considered the following financing alternatives:

- Alternative 1: Obtain external financing
- Alternative 2: Borrow internally from Utility Surplus

Alternative 1 (Not Recommended) – Obtain External Financing

The City may obtain external financing for capital purposes in accordance with 179(1)(a) of the *Community Charter*. Further, under Section 7 of the *Municipal Liabilities Regulation* states that, “Approval of the electors is not required under section 180(1) [loan authorization bylaws] of the *Community Charter* if: (a) at the time it proposes to incur the liability, (i) the annual cost of servicing the aggregate liabilities of the municipality for the year ... does not exceed (ii) 5% of the annual calculation revenue of the municipality for the previous year ... and (b) incurring the liability would not cause the annual cost referred to in paragraph (a) (i) to exceed the limit established by paragraph (a) (ii).”

External debt financing in the amount of \$12.3M contributes to the total debt balance held by the City and the associated servicing costs are included when evaluating the requirement for elector approval for external borrowing. The following shows the calculation of the City’s “approval-free liability zone” if borrowing takes place in 2014:

Calculation of the “approval-free liability zone”

2013 Annual Calculation Revenue	\$350M
5% limit	<u>5%</u>
2014 Total Approval-Free Liability Zone	<u>\$17.5M</u>
Existing 2014 Annual Liability Servicing Costs	<u>\$7M</u>
Remaining Annual Liability Servicing for 2014	\$10.5M
<b>ADEU Phase 3 Expansion Annual Servicing Costs</b> (\$12.3M at 5% for 15 years)	<b>\$1.2M</b>

The remaining annual liability servicing of \$10.5M is the current available balance prior to any additional external debt related to the Phase 3 expansion or new commitments/agreements that the City may enter into that would increase the total liabilities serviced by the City.

Interest on external borrowing of \$12.3M is estimated at \$9.3M over the duration of the loan (based on 5% for 15 years). The interest rate can only be locked in for the first 10 years, the rate will be reset after the initial 10 year period to the applicable rate at the time.

External debt would also add additional complications for the process of transferring ADEU assets to LIEC.

Alternative 2 (Recommended) – Borrow internally from Utility General Surplus

The cost of the Phase 3 expansion may be funded by the City’s existing Utility General Surplus which has a current balance of \$24.4M. The Utility General Surplus balance is comprised of Water and Sanitary Sewer General Surplus balances of \$15.2M and \$9.2M respectively. The Utility General Surplus is not restricted in use (like Reserves) or directed for a specific purpose (like Appropriated Surplus). Any internal borrowing from existing surplus funds is required to be repaid with interest.

The timing of the internally borrowed funds can be adjusted to match the timing of construction over the next 3-5 years. The repayments will be funded by revenues generated from the customer rates. The repayment terms can be arranged to correspond to the timing of revenues received. The revenues will increase over the first three years of the Phase 3 expansion as the additional developments are completed. Table 4 summarizes both alternatives.

Table 4: Comparison of the Financing Alternatives

	<b>Alternative 1: External Borrowing</b>	<b>Alternative 2: Internal Borrowing</b>
<b>Financing Threshold</b>	No elector approval required: Up to an additional borrowing of \$125M ("approval-free liability zone")	Up to \$24.4M of Utility Surplus available for borrowing.
<b>Advantages</b>	Internal funds remain available for other initiatives  First 10 years of borrowing can be locked in at low rates (approximately 3.3% July 2014), but the rate is unknown after 10 years	Internal borrowing does not require elector approval  External interest charges will be avoided  Internal funds are general and not directed for capital purposes  Payment terms can be arranged to match timing of revenues from operations
<b>Disadvantages</b>	Reduction of the Approval-Free Liability Zone  Elector approval required if Approval-Free Liability Zone limits are surpassed  Payment terms are inflexible  Timing of construction would require amounts to be borrowed in advance of capital construction  Increased complexity for the ADEU assets transfer to LIEC	Opportunity cost of utilizing these funds
<b>Costs</b>	Total interest payment of \$9.3M or approximately 75% of the amount borrowed (over a term of 15 years at 5%)	None – all borrowing will be repaid with interest (current business model estimates 5%)

When compared to how DE is being funded for City Centre, Alexandra DEU and City Centre DEU have two very different business models. The difference is that the City finances, builds, operates and maintains the ADEU and collects all revenues. The City Centre DEU on the other hand, is built, maintained, operated and financed by City partner; City collects the revenue, but pays partner their portion. Also, estimated total capital investment at the full build out for the ADEU is \$23.3M, while the total capital investment at the full build out for the City Centre DEU can be up to \$142M. Due to the scale difference between ADEU and City Centre DEU, internal financing is the preferred option.

Based on the above analysis, staff recommend that up to \$12.3M in funding be approved from the Water Utility General Surplus for the Phase 3 capital costs. All borrowed amounts will be repaid with interest and are incorporated into the financial model. Internal borrowing is recommended due to many variables including the time-span of construction, servicing requirements, and the availability of funding.

### **Financial Impact**

Staff recommend that \$12.3 million be submitted for Council consideration as part of the Five Year Financial Plan (2015-2019) with funding approved through borrowing from the Water Utility General Surplus. The cash flows scheduled for this borrowing and payback are detailed in Attachment 2.

### **Conclusion**

Preliminary design concepts for the expansion of the Alexandra DEU system have been completed to service four new developments starting in 2015 and three more developments by 2018. It is recommended to include additional geexchange fields in the West Cambie Neighbourhood Park for thermal energy, with supplemental conventional energy systems for back up. It is recommended that \$12.3M in funding be provided from the Water Utility General Surplus for design, construction and commissioning of Phase 3 system expansion to service new ADEU customers.

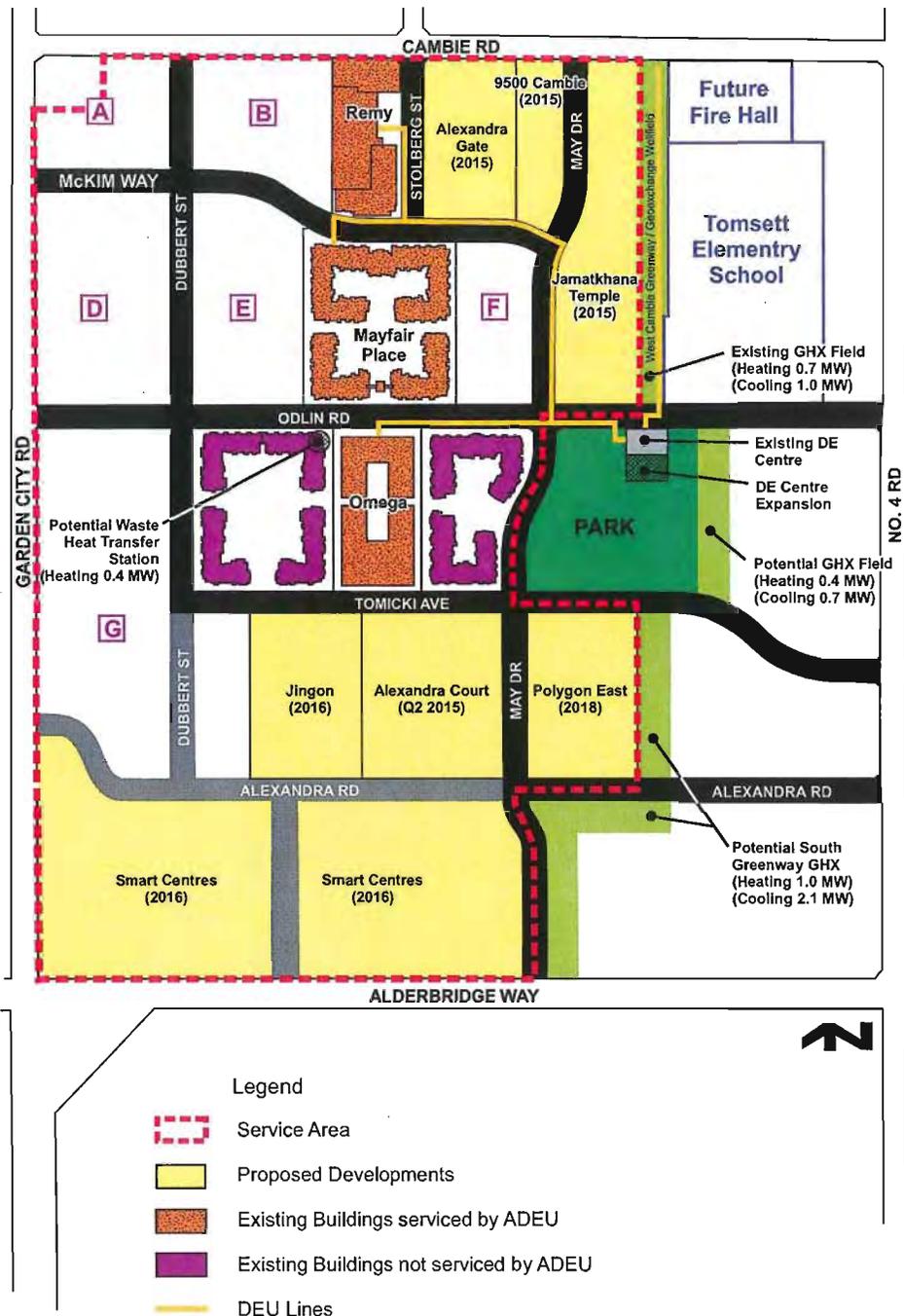


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AP:ap

Att. 1: Alexandra Neighbourhood and ADEU Service Area Development  
2: ADEU Financial Analysis Model

Attachment 1 – Alexandra Neighbourhood and ADEU Service Area Development



**Attachment 2 – ADEU Financial Analysis Model (to build-out)**

(Preliminary draft based on current assumptions. Financial Model is subject to change as these facts and assumptions change.)

(All dollar figures are in thousands of dollars)											
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 10	Year 15	Year 20	Year 25	Year 30	
	2011	2012	2013	2014	2015	2020	2025	2030	2035	2040	
TOTAL REVENUE	\$ -	\$ 72	\$ 479	\$ 817	\$ 1,797	\$ 3,548	\$ 5,474	\$ 6,660	\$ 8,102	\$ 9,858	
TOTAL EXPENSES	\$ -	\$ 6	\$ 181	\$ 495	\$ 791	\$ 1,381	\$ 2,068	\$ 2,507	\$ 3,094	\$ 3,771	
DEBT INTEREST EXPENSE	\$ -	\$ -	\$ -	\$ -	\$ 535	\$ 1,204	\$ 1,169	\$ 417	\$ -	\$ -	
PROJECTED OPERATION INCOME (LOSS) BEFORE AMORTIZATION	\$ -	\$ 65	\$ 298	\$ 322	\$ 471	\$ 963	\$ 2,236	\$ 3,735	\$ 5,008	\$ 6,086	
Principal Payment	\$ -	\$ -	\$ -	\$ -	\$ 535	\$ 1,341	\$ 1,648	\$ 1,331	\$ -	\$ -	
PROJECTED CASHFLOW	\$ -	\$ 65	\$ 298	\$ 322	(\$ 63)	(\$ 379)	\$ 588	\$ 2,404	\$ 5,008	\$ 6,086	
Cumulative Project Cashflow	\$ -	\$ 65	\$ 363	\$ 685	\$ 622	\$ 764	\$ 2,055	\$ 8,246	\$ 28,939	\$ 57,090	
Internal Rate of Return (IRR) over 30 years:											
CAPITAL INVESTMENT*	(\$ 2,300)	(\$ 2,066)	\$ -	(\$ 3,425)	(\$ 3,768)	\$ -	\$ -	\$ -	(\$ 5,351)	\$ -	
Annual Cash Inflow from Operation	\$ -	\$ 65	\$ 298	\$ 322	\$ 471	\$ 963	\$ 2,236	\$ 3,735	\$ 5,008	\$ 6,086	
Net Annual Cashflow of Investment	(\$ 2,300)	(\$ 2,001)	\$ 298	(\$ 3,103)	(\$ 3,297)	\$ 963	\$ 2,236	\$ 3,735	(\$ 342)	\$ 13,012	
CUMULATIVE DEBT LOAD	\$ 2,518	\$ 4,813	\$ 5,054	\$ 8,813	\$ 12,377	\$ 20,434	\$ 12,392	\$ 2,192	\$ 10,561	\$ 14,471	
CUMULATIVE PROJECTED NET INCOME	(\$ 50)	(\$ 91)	\$ 101	\$ 177	\$ 313	\$ 1,081	\$ 6,396	\$ 17,123	\$ 35,339	\$ 58,076	
	IRR:	8.01%									
	NPV:	\$ 4,758									
Payback Period:	19 year	(time to recover original investment of \$23.3 M from operation income)									

The projections are based on prospective results based on assumptions about future conditions and courses of action. The current model assumes internal borrowing for Phase 3 at an interest rate of 5% over 15 years.

\*Includes an estimation of the remaining value of capital equipment.