

Langstaff Secondary Plan Area

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## **Vacuum Waste Collection Financial Feasibility Report**

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REPORT PREPARED FOR

**The City Of Markham**



REPORT PREPARED BY



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# 1 INTRODUCTION

## 1.1 Background

The concept of implementing a Vacuum Waste Collection System within a new development area of Markham, has been the topic of discussion and study for many years. This discussion culminated into a Workshop which took place on February 23, 2021 which was attended by the Mayor, Local and Regional Councillors, Senior Staff, Developers, and industry leaders from both Canada and Sweden. One of the action items resulting from this Workshop was for the City to undertake a financial analysis evaluating the feasibility of implementing such a system.

As a result of this workshop, The Municipal Infrastructure Group Ltd. (TMIG|TYLI) has been retained by the City of Markham to undertake a financial feasibility analysis for the implementation of an Automated Vacuum Waste Collection system (AVAC), specifically to service the Langstaff Secondary Plan Area (Langstaff) in the City of Markham.

The Langstaff Area covers about 47 hectares (116 ac.) and is located in the south-west part of the City and is bounded by Highway 407 to the north, the Holy Cross Cemetery to the south, Bayview Avenue to the east, and Yonge Street to the west. Langstaff is proposed to include a mix of land uses including commercial, retail, office, and high-density residential units.

Since Langstaff is a new community development, the residential and commercial units will be constructed and occupied in phases. This implies that solid waste generation from the new development will be in phases and will increase gradually. Thereby, the design of the AVAC system for Langstaff must accommodate the phased concept of the development.

This project involved the collection of all background data acquired by the City to-date, and this data was supplemented with preliminary concept design and cost estimates to support the financial analysis.

As outlined in our proposal, this analysis comprises three primary deliverables:

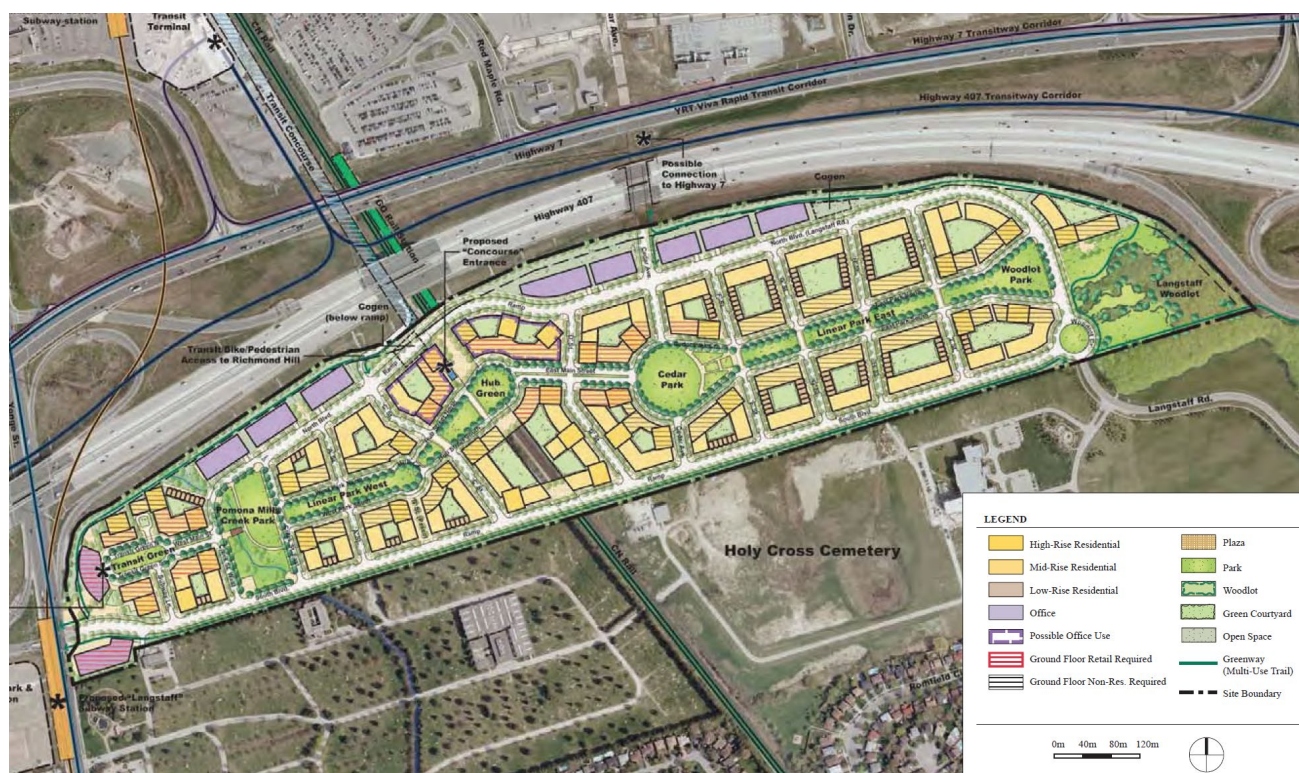
1. A Cash Flow spreadsheet, providing a detailed breakdown of the community buildout phasing, capital costs (phased), operational costs (phased), and funding/revenues/fees required to support the system development and operation.
2. A Business-As-Usual vs Vacuum Waste Collection financial comparison, comparing both capital and operational expenditures
3. A brief report summarizing the findings and any recommendations.

## 2 LANGSTAFF SECONDARY PLAN AREA

### 2.1 Servicing Area

As noted above, the Langstaff Secondary Plan Area covers 47 hectares (116 ac.) and is proposed to include a mix of land uses including commercial, retail, office, and high-density residential units. The following summarizes the anticipated quantity of each land use, based on the original approved Secondary Plan concept.

- 15,000 residential units
- 746,000 sq ft of Retail and Commercial GFA
- 206,260 sq ft of Community Services GFA
- 2,401,967 sq ft of Office GFA



**Figure 1 Langstaff Secondary Plan Area**

## 2.2 Development Phasing

The Langstaff Secondary Plan development will commence construction in 2022 and is anticipated to build out over a 43 year timeframe. First occupancies are anticipated in 2023. The three phases have been identified as follows:

- Phase 1 – 2022 to Subway Opening in 2035
- Phase 2 – Post Subway Opening to Opening of 407 Transitway in 2050
- Phase 3 – Post 407 Transitway to Full Buildout in 2065

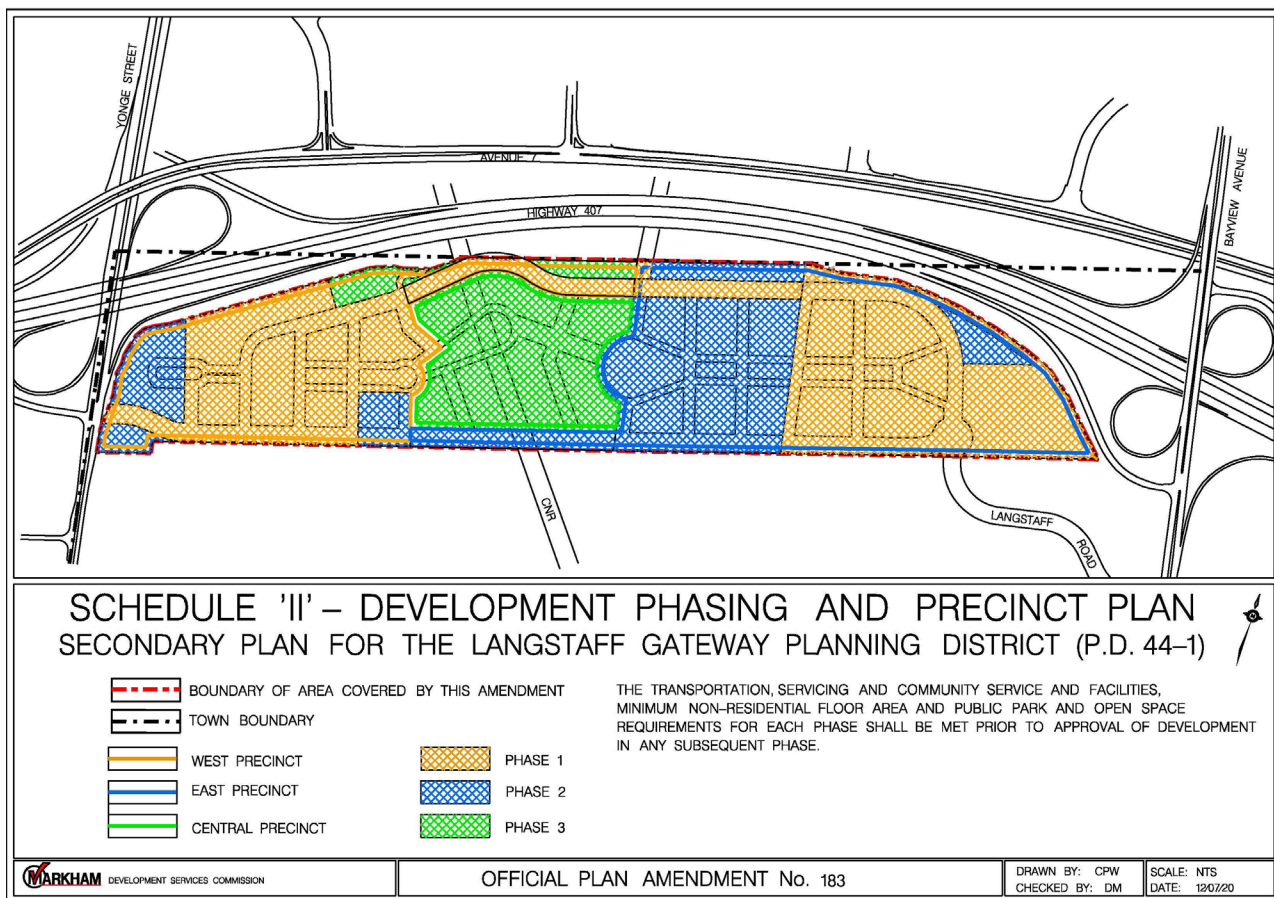
The following table summarizes the anticipated buildout breakdown for each phase:

**Table 2-1 Development Phasing**

|   | <b>Phase 1<br/>2022-2035</b> | <b>Phase 2<br/>2036-2050</b> | <b>Phase 3<br/>2051-2065</b> |
|---|------------------------------|------------------------------|------------------------------|
| Total Residential Units                 | 5,000                        | 3,650                        | 6,350                        |
| Total Retail and Commercial GFA (sq ft) | 232,500                      | 218,500                      | 295,000                      |
| Total Community Services GFA (sq ft)    | 65,660                       | 57,600                       | 83,000                       |
| Total Office GFA (sq ft)                | 361,667                      | 1,430,300                    | 610,000                      |
|   |                              |                              |                              |
| Years Annualized                        | 13                           | 15                           | 15                           |
| Residential Units/year                  | 385                          | 243                          | 423                          |
| Retail and Commercial GFA/year (sq ft)  | 17,885                       | 14,567                       | 19,667                       |
| Community Services GFA/year (sq ft)     | 5,051                        | 3,840                        | 5,533                        |
| Office GFA/year (sq ft)                 | 27,821                       | 95,353                       | 40,667                       |

The following figure delineates the areas comprising each of the three phases.





**Figure 2 Development Phasing**

## 2.3 Solid Waste Generation

Utilizing the development buildout and land use projections referenced above, combined with Markham's historical waste generation rates, waste quantities produced by the proposed Langstaff development can be estimated.

The following data was utilized to estimate the waste volumes being generated. These waste volumes are calculated for the three primary waste fractions comprising, mixed waste, recyclables, and kitchen organic waste.

**Table 2-2 Multi-Residential Waste Generation Rates in Markham**

| Waste Fraction | kg/unit/day | lbs/unit/day |
|----------------|-------------|--------------|
| Mixed Waste    | 0.86        | 1.9          |
| Recyclables    | 0.25        | 0.55         |
| Organics       | 0.19        | 0.42         |
| <b>Total</b>   | <b>1.3</b>  | <b>2.87</b>  |

**Table 2-3 Typical Non-Residential Waste Generation Rates**

| Non-Residential Land Use | kg/m2/day | lbs/ft2/day |
|--------------------------|-----------|-------------|
| Retail/Commercial        | 0.063     | 0.13        |
| Office                   | 0.029     | .006        |

Recognizing that different land uses generate different volumes of waste, an equivalent # of dwelling units can be established

**Table 2-4 Equivalent # Domestic Units**

| Land Use               | Waste Generation Rate         | Equivalent # Units Factor  | Equivalent # Units Factor    |                           | Equivalent # Units |
|------------------------|-------------------------------|----------------------------|------------------------------|---------------------------|--------------------|
| Multi-Unit Residential | 2.87 lbs/unit/day             | 1                          | 1                            | 15,000 units              | 15000              |
| Retail/Commercial      | 0.13 lbs/ft <sup>2</sup> /day | 20.52 m <sup>2</sup> /unit | 220.88 ft <sup>2</sup> /unit | 746,000 ft <sup>2</sup>   | 3378               |
| Office                 | 0.06 lbs/ft <sup>2</sup> /day | 44.45 m <sup>2</sup> /unit | 478.47 ft <sup>2</sup> /unit | 2,401,967 ft <sup>2</sup> | 5020               |
| <b>TOTAL</b>           |                               |                            |                              |                           | <b>23,397</b>      |

**Table 2-5 Waste Generated Within Langstaff**

| Land Use                        | Equivalent # Units | kg/unit/day | Tonnes/day |
|---------------------------------|--------------------|-------------|------------|
| Residential and Non-Residential | 23,397 units       | 1.3         | 30.4       |



## 2.4 Waste Room Storage Requirements

Through traditional waste collection services, waste from the three primary fractions from multi-unit residential buildings and commercial/office buildings are deposited into front end loading bins (FEL bins) and jockeyed from the waste storage room into a loading zone for FEL truck pick-up on collection day.

Waste storage rooms within these buildings comprise two components

- FEL bin storage
- Bulky waste storage

The bulk waste storage space is to accommodate large items such as furniture and white goods (appliances etc.) These are collected separately from the FEL bins and City criteria specifies a minimum of 20m<sup>2</sup> of storage space be provided for multi-unit residential buildings.

The building waste room storage requirements to accommodate the multi-unit residential FEL bins can be estimated using the following City of Markham criteria.

**Table 2-6 City of Markham Criteria - Minimum Size of Residential Waste Storage Room**

| Number of Dwelling Units | Minimum Number of Front-End Containers |                           |                        | Minimum Size of Waste Storage Room |
|--------------------------|--|---------------------------|------------------------|------------------------------------|
|                          | Garbage (4yd)                          | Recyclable Material (4yd) | Organic Material (4yd) |                                    |
| 33 to 45                 | 2                                      | 2                         | 2                      | 36 m <sup>2</sup>                  |
| 46 to 90                 | 2                                      | 3                         | 2                      | 40 m <sup>2</sup>                  |
| 91 to 135                | 3                                      | 4                         | 2                      | 48 m <sup>2</sup>                  |
| 136 to 180               | 3                                      | 5                         | 3                      | 59 m <sup>2</sup>                  |
| 181 to 225               | 4                                      | 6                         | 3                      | 63 m <sup>2</sup>                  |
| 226 to 270               | 4                                      | 7                         | 3                      | 66 m <sup>2</sup>                  |
| 271 to 315               | 5                                      | 8                         | 4                      | 77 m <sup>2</sup>                  |
| 316 to 360               | 5                                      | 9                         | 4                      | 93 m <sup>2</sup>                  |
| 361 to 400               | 6                                      | 10                        | 4                      | 102 m <sup>2</sup>                 |
| 401 to 445               | 6                                      | 11                        | 5                      | 110 m <sup>2</sup>                 |
| 446 to 490               | 7                                      | 12                        | 5                      | 120 m <sup>2</sup>                 |
| 491 to 535               | 7                                      | 13                        | 5                      | 125 m <sup>2</sup>                 |

The minimum size of waste storage room noted in this table are in addition to the 20m<sup>2</sup> storage space required for bulky waste goods.

Recognizing that the approved Langstaff Secondary Plan anticipates 66 buildings, and the total equivalent number of domestic units amounts to 23,397 units, it can be estimated that the “average” building will comprise 355 equivalent domestic units.

Utilizing Table 2-6, the average building with 355 equivalent domestic units would require a minimum of 93m<sup>2</sup> (1001 ft<sup>2</sup>) of FEL bin storage space.

Across the entire development, the minimum FEL bin storage space for the 66 buildings would amount to approximately 6138m<sup>2</sup> (66,000 ft<sup>2</sup>)

## 3 VACUUM WASTE COLLECTION

### 3.1 Overview

As an alternative to traditional solid waste truck collection, the automated vacuum waste collection systems (AVAC) was developed in the early 1960's, in Sweden, by the Envac Corporation to convey waste from multiple buildings through underground pipes to a central collection facility. This technology has been used in thousands of communities since inception throughout Europe, the Middle East, China, and more recently in the UK. The technology has been found to be very reliable and has withstood the test of time.

An AVAC system was installed over 50 years ago to collect waste from Roosevelt Island in New York and this system remains in operation today.

An AVAC system was also installed within the last 10 years in the Cite Verte community of Quebec City, which services a mixed-use community including approximately 1000 residential units.

A number of commercial AVAC systems have also been implemented within hospitals and airports within North America.

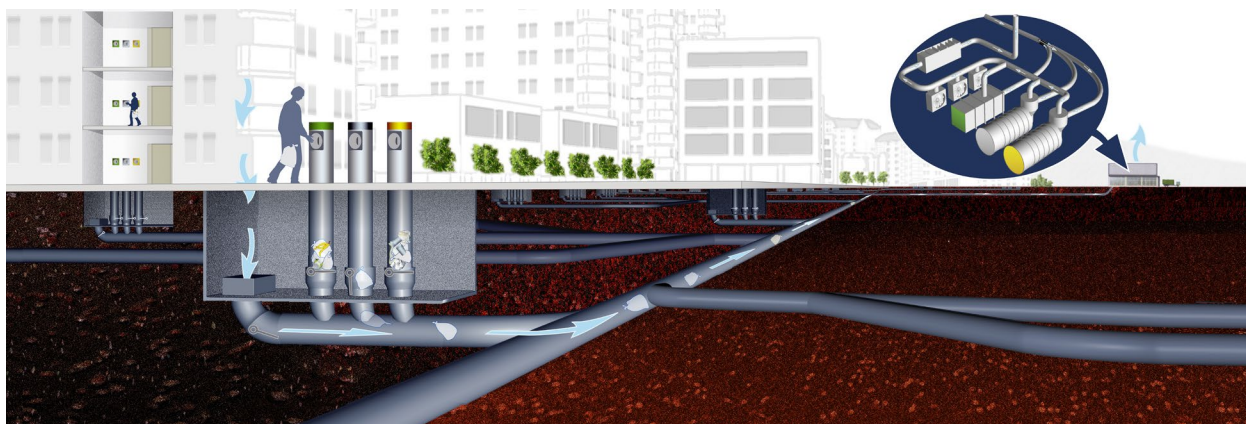
While there are some installations in North America, the technology has not yet been embraced here on a community wide basis.

There are many benefits attributed to the AVAC system, but given the financial focus of this report, the environmental and social benefits will not be discussed.

### 3.2 AVAC System Components

As noted above, the AVAC system conveys waste from multiple buildings, through underground pipes, to a central collection facility. The system comprises the following components:

- Indoor waste inlets
- Outdoor waste inlets/self emptying litter bins
- Pipes
- Central Terminal



*Figure 3 AVAC System Components (courtesy of Envac)*

### Indoor Waste Inlets –

Indoor waste inlets are located on each floor of the residential and commercial/office buildings, and these are connected to the building's waste chutes. A separate access door is provided for each waste fractions (ie general waste, recyclables, organics). Once the waste is deposited by the user into the waste inlet, no further human contact is made with this waste. The waste is temporarily stored in the chutes and a waste valve is opened by an electronic signal sent from the collection terminal. Bags fall into the pipe by gravity and are then transported by negative pressure through the pipes at 70km/hr to the central terminal



### Outdoor Waste Inlets/Self Emptying Litter Bins –

These function the same as the indoor waste inlets, with waste collected 24/7/365.



### Pipes –

The pipes are generally 500mm in diameter and are made of weld joined steel. One single pipe conveys the waste from each of the fractions at separate times throughout the day. Timing of fraction conveyance is scheduled to minimize contamination of recyclable materials.

### Central Terminal –



At the terminal, waste bags arrive, and a diverter valve sorts the bags into different waste containers depending on the type of waste stream collected. Waste is separated from the air and waste bags are pushed into the container where they are compacted. Once the container is full, it is replaced by a empty container, and the full container is loaded onto a “roll-off bin” truck where it is transported to the disposal destination.

*(Photo of Central Terminal in Cite Verte Quebec, courtesy of Envac)*

### 3.3 Langstaff Preliminary System Design

In order to undertake a financial feasibility study for the implementation of an AVAC system in the Langstaff Secondary Plan area, a preliminary system design for Langstaff was undertaken. With this preliminary design, Capital and Operational costs can be derived. The AVAC system design for Langstaff was based on the following principals/assumptions:

- System design is to reflect the physical constraints of the site with the primary constraint being the rail corridor which bisects the community. Two separate systems, an East system and a West system were carried as a result, with two separate central waste terminals. No AVAC infrastructure is proposed to cross the rail corridor, either above or below grade.
- System design is to reflect the 3 Phases of development buildout as identified in Section 2.2 above. While both of the Central Terminals would be required at project start up, the piping, building connections, and park self-emptying litter bin infrastructure could be phased along with the community build-out
- The Central Terminals are proposed to be located on park lands to be conveyed to the City. Terminals were, as a result, situated within the linear park system immediately adjacent to a public road for truck access. The terminal infrastructure is assumed to be located primarily underground with a ramp down to the terminal for truck container loading by a “roll on- roll off bin truck”.
- Three fraction collection is to be accommodated in all buildings, including general waste, organics, and recyclables. The system is to be designed to accommodate a waste volume of 30.4 tonnes/day
- Bulk goods, household hazardous waste, and electronic waste will be managed and collected as per “business-as-usual” (BAU).
- Given the nature of this development (Condo mid/high-rise Residential and Commercial), yard waste will be collected and removed by the Condo Corporation’s landscape contractor, as per BAU.
- Each building connection will include the necessary piping from the street to the building valve room. The valve room in each building will contain equipment which connects to the building’s waste chute system (3-fractions). In addition, one self-emptying litter bin (1-fraction) has been assumed to service the outdoor amenity space associated with each building
- Within the park areas, self emptying litter bins (1 fraction) will be connected to the AVAC system to collect general waste only (ie no organics or recyclables) as per current City operations. While twenty-seven bins were initially identified as part of the preliminary design, twelve self-emptying litter bins were ultimately carried in the capital cost estimates to reflect the “business-as-usual” waste receptacle requirements identified by the City Parks staff. The impact of 27 vs. 12 self emptying litter bins is not material to the overall findings of this report. These self emptying litter bins servicing the parks will be located such that they could be serviced/connected to the vacuum waste pipes constructed within the roadways, as opposed to constructing a separate pipe system within the parks specifically for these litter bins.
- It is assumed that separate waste receptacles typically provided within Markham’s roadways at bus stops etc, which are currently supplied, operated, and paid for by advertisers, will be installed maintained, and emptied manually, and not be connected the AVAC system.

The following figure presents the preliminary system configuration, based on the above assumptions.





**Figure 4 Preliminary AVAC System Design - Langstaff Secondary Plan Area**

### 3.4 Capital and Operational Cost Estimates

Utilizing the preliminary design described above, the following capital cost estimate, on a phased basis, was prepared and summarized below.

**Table 3-1 Capital Cost Estimate**

|                                  | <b>Phase 1<br/>2022-2035</b> | <b>Phase 2<br/>2036-2050</b> | <b>Phase 3<br/>2051-2065</b> |
|----------------------------------|------------------------------|------------------------------|------------------------------|
| <b>East System</b>               |                              |                              |                              |
| Pipes in Roadways                | \$ 461,000                   | \$ 666,000                   | \$ 308,000                   |
| Building Connections             | \$ 1,740,000                 | \$ 2,320,000                 | \$ 2,030,000                 |
| Parks Infrastructure             | \$ 60,000                    | \$ 139,000                   | \$ 0                         |
| Central Terminal                 | \$ 7,185,000                 | \$ 0                         | \$ 0                         |
| <b>Total East System</b>         | <b>\$ 9,446,000</b>          | <b>\$ 3,125,000</b>          | <b>\$ 2,338,000</b>          |
| <b>West System</b>               |                              |                              |                              |
| Pipes in Roadways                | \$ 564,000                   | \$ 308,000                   | \$ 205,000                   |
| Building Connections             | \$ 2,030,000                 | \$ 580,000                   | \$ 870,000                   |
| Parks Infrastructure             | \$ 139,000                   | \$ 30,000                    | \$ 30,000                    |
| Central Terminal                 | \$ 7,185,000                 | \$ 0                         | \$ 0                         |
| <b>Total West System</b>         | <b>\$ 9,917,000</b>          | <b>\$ 918,000</b>            | <b>\$ 1,105,000</b>          |
| <b>20% Contingency</b>           | <b>\$ 3,873,000</b>          | <b>\$ 809,000</b>            | <b>\$ 689,000</b>            |
| <b>Total East + West Systems</b> | <b>\$ 23,236,000*</b>        | <b>\$ 4,852,000*</b>         | <b>\$ 4,132,000*</b>         |

The total Capital Cost for both the East and West System, all phases, amounts to **\$32,220,000**.

This Capital Cost estimate assumes:

- No adverse soil conditions
- AVAC piping will be installed concurrently with the typical municipal infrastructure (sewers, watermain etc.)
- Sufficient room is available within the roadways to accommodate the AVAC pipe infrastructure
- The extent of self-emptying litter bin infrastructure within the parks have been reduced to reflect the “business-as-usual” waste receptacle requirements identified by the City Parks staff.
- 20% contingency applied to all capital and operating costs provided by AVAC suppliers



**Table 3-2 Yearly Operational Cost Estimate**

| Item  | Cost                |
|---|---------------------|
| <b>State of Good Repair Costs</b>             |                     |
| AVAC System State of Good Repair              | \$200,000           |
| Terminal Building State of Good Repair        | \$ 50,000           |
| 20% Contingency                               | \$ 50,000           |
| <b>Operating Costs</b>                        |                     |
| Waste Haulage to WMF                          | \$ 184,000          |
| Recyclable Haulage to WMF                     | \$ 153,000          |
| Organic Haulage to WMF                        | \$ 61,000           |
| Parks Litter Bin Haulage to WMF               | \$ 10,000           |
| Operational Staff – Supervisor x1             | \$ 104,000          |
| Operational Staff – Technician x2             | \$ 166,000          |
| Equipment Energy Consumption                  | \$ 192,000          |
| AVAC System Spare Parts                       | \$ 100,000          |
| Terminal Building Energy Consumption          | \$ 50,000           |
| Terminal Building Spare Parts and Maintenance | \$ 20,000           |
| <b>Total Yearly Operational Costs</b>         | <b>\$ 1,340,000</b> |

Note: 20% contingency was applied to State of Good Repair Costs only

Recyclable Haulage Costs to be paid for by Producer Responsible Organization (starting in 2026)

## 4 FINANCIAL FEASIBILITY

### 4.1 Assumptions

A cash flow model was set up to allow various parameters to be tested as part of a financial sensitivity analysis (see Appendix A). The following assumptions were utilized in the creation of this financial model:

- The entire AVAC system (valve room equipment, piping, outdoor inlets, and terminal) will be owned and operated by the City of Markham
- All costs and revenues to be phased in accordance with the phasing outlined above in Section 2.2
- The two central waste terminals are to be located on park lands to be conveyed to the City. No land lease costs have been carried as a result.
- Waste from all three fractions to be hauled from the Central Terminals to the Earl Turcott Waste Management Facility on Roddick Road
- Revenues:
  - City – In order to identify any gap in funding, it was assumed that the City would contribute funds based on BAU waste collection
  - Producer Responsible Organization (PRO) to be responsible for paying up to 100% of the collection, haulage, processing costs for all residential recyclables as of 2026. PRO fees based on BAU costs have been discounted by 50% to reflect uncertainty around process
  - Builders to be charged a building connection fee, primarily based on cost savings that they will incur by significantly reducing the amount of waste bin storage required in each building compared to BAU
  - Condo Corporations (residential and commercial/office) will be charged an annual system fee, primarily based on cost savings that they will incur by not having to jockey, maintain, and replace the FEL bins as they would under BAU
- Annual State of Good Repairs costs are to provide sufficient funds to allow for the indefinite operation of the system
- No spare parts costs are carried for first five years of system operation
- Only two of three full time staff are required in first five years of system operation
- Operating costs, where applicable, are prorated in alignment with increase in waste generation over time.
- No external funding courses, such as government agency grants or low interest loans are factored into this analysis.
- Net Present Value (NPV) discount rate set to equal inflation rate as per direction of City staff.

## 4.2 Capital and Operating Costs BAU vs. AVAC

The following table provides a comparison of Business as Usual Capital and Operating Costs vs. the AVAC System Capital and Operating Costs.

**Table 4-1 BAU vs. AVAC**

|  |  | 1                 | 2                          | 3                                   | 4                    | 5                                    |
|--|--|-------------------|----------------------------|-------------------------------------|----------------------|--------------------------------------|
|  | Items  | BAU CITY          | BAU RESIDENTIAL<br>BUILDER | BAU RES and NON-<br>RES CONDO CORP. | TOTAL BAU            | VWCS<br>(3 Streams + Litter<br>Bins) |
| <b>Parameters</b>                            | Collection Method                              | Current           |                            |                                     |                      | Vacuum                               |
|  | Number of Equivalent Residential Units         | 23397             |                            |                                     | 23397                | 23397                                |
|  | Waste Generation Forecast Source               | VWCS Manufacturer |                            |                                     |                      | VWCS Manufacturer                    |
|  | Garbage Collection                             | Yes               |                            |                                     |                      | Yes                                  |
|  | Organics Collection                            | Yes               |                            |                                     |                      | Yes - CS and MR                      |
|  | Recycling Collection                           | Yes               |                            |                                     |                      | Yes                                  |
|  | BIA/ICI Collection                             | Yes               |                            |                                     |                      | Yes                                  |
|  | Public Litter Bin Collection                   | Yes - Traditional |                            |                                     |                      | Yes - Vacuum                         |
|  | Bulky Items Collection                         | Yes               |                            |                                     |                      | No                                   |
|  | Total Material Collected (Tonnes/Day)          | 30.4              |                            |                                     | 30.4                 | 30.4                                 |
| <b>Capital Costs</b>                         | Residential/Commercial FEL Waste Bins          |                   | \$ 1,544,400               |                                     | \$ 1,544,400         |                                      |
|  | Residential/Commercial FEL Storage Space       |                   | \$ 16,532,167              |                                     | \$ 16,532,167        |                                      |
|  | Park Waste Receptacles 1 Fraction              | \$ 10,800         |                            |                                     | \$ 10,800            |                                      |
|  | Park Waste Collection Trucks                   | \$ 145,896        |                            |                                     | \$ 145,896           |                                      |
|  | Pipes  |                   |                            |                                     | \$ -                 | \$ 3,013,500                         |
|  | Bld. Connects                                  |                   |                            |                                     | \$ -                 | \$ 11,484,000                        |
|  | Parks  |                   |                            |                                     | \$ -                 | \$ 476,400                           |
|  | Terminal                                       |                   |                            |                                     | \$ -                 | \$ 17,244,000                        |
|  |  |                   |                            |                                     | \$ -                 |                                      |
|  | <b>Total Capital Costs</b>                     | <b>\$ 156,696</b> |                            |                                     | <b>\$ 18,233,263</b> | <b>\$ 32,217,900</b>                 |
| <b>Annual State of Good<br/>Repair Costs</b> | Residential/Commercial FEL Waste Bins          | \$ -              |                            | \$ 308,880                          | \$ 308,880           |                                      |
|  | Park Waste Receptacles                         | \$ 360            |                            |                                     | \$ 360               |                                      |
|  | Park Waste Collection Trucks                   | \$ 29,837         |                            |                                     | \$ 29,837            |                                      |
|  | VWCS Equipment Updating (Year 7+)              |                   |                            |                                     | \$ -                 | \$ 200,000                           |
|  | Building State of Good Repair (Year 5+)        |                   |                            |                                     | \$ -                 | \$ 50,000                            |
|  | Allowance (20%)                                | \$ 18,000         |                            |                                     | \$ 18,000            | \$ 50,000                            |
|  |  |                   |                            |                                     | \$ -                 |                                      |
|  | <b>Total Annual State of Good Repair Costs</b> | <b>\$ 48,197</b>  |                            |                                     | <b>\$ 357,077</b>    | <b>\$ 300,000</b>                    |
| <b>Annual Operating Costs</b>                | Res/ICI Waste Collection - Garbage             | \$ 315,470        |                            |                                     | \$ 315,470           |                                      |
|  | Res/ICI Waste Collection - Organics            | \$ 69,058         |                            |                                     | \$ 69,058            |                                      |
|  | Res/ICI Waste Collection - Recycling           | \$ 305,791        |                            |                                     | \$ 305,791           | \$ -                                 |
|  | Parks Waste Collection                         | \$ 10,000         |                            |                                     | \$ 10,000            |                                      |
|  | Residential Bin Jockeying                      |                   |                            | \$ 205,920                          | \$ 205,920           |                                      |
|  | Waste Haulage - Garbage                        |                   |                            |                                     | \$ -                 | \$ 183,610                           |
|  | Waste Haulage - Organics                       |                   |                            |                                     | \$ -                 | \$ 61,462                            |
|  | Waste Haulage - Recycling                      |                   |                            |                                     | \$ -                 | \$ 152,500                           |
|  | Waste Haulage - Cardboard                      |                   |                            |                                     | \$ -                 | \$ -                                 |
|  | Waste Haulage - Public Litter Bins             |                   |                            |                                     | \$ -                 | \$ 10,000                            |
|  | Supervision Staff                              |                   |                            |                                     | \$ -                 | \$ 104,000                           |
|  | Operation Staff                                |                   |                            |                                     | \$ -                 | \$ 166,400                           |
|  | VWCS Energy Consumption (\$0.16/kwhr)          |                   |                            |                                     | \$ -                 | \$ 192,000                           |
|  | VWCS Spare Parts                               |                   |                            |                                     | \$ -                 | \$ 100,000                           |
|  | Building Energy Consumption                    |                   |                            |                                     | \$ -                 | \$ 50,000                            |
|  | Misc. Building Contracts and Expenditures      |                   |                            |                                     | \$ -                 | \$ 20,000                            |
|  | <b>Total Annual Operating Costs</b>            | <b>\$ 700,319</b> |                            |                                     | <b>\$ 906,239</b>    | <b>\$ 1,039,973</b>                  |
| <b>Total Annual Costs</b>                    | <b>Total Annual Costs</b>                      | <b>\$ 748,516</b> |                            |                                     | <b>\$ 1,263,316</b>  | <b>\$ 1,339,973</b>                  |
|  | Overall Collection Costs/Tonne                 | 67.60             |                            |                                     | 114.09               | 121.01                               |
|  | Overall Collection Costs/Unit res/non-res      | 31.99             |                            |                                     | 53.99                | 57.27                                |

## 4.3 Findings

### Costs

- Capital Costs for the AVAC system, including 20% contingency, is estimated to be **\$32M**.
- Yearly Operational Costs for the AVAC system is estimated to be \$1.34M/year at full buildout. Recognizing that Operational Costs will increase yearly as the development builds out, the total Operational Cost over the 43 year build-out (2065) amounts to approximately **\$40.2M**
- The presence of the rail corridor, which bi-sects the Langstaff Community lands, drives the need for two separate AVAC systems. Since Phase 1 of the development includes lands on both the east and west sides of the rail corridor, significant upfront costs are required to develop the two AVAC systems with limited opportunities to defer/phase the central waste terminal costs. Should it be determined that pipe crossings of this corridor are feasible and one central waste terminal can be constructed to service both the west and east sides of this corridor, then a cost reduction could potentially be realized related to the Central Terminals.
- The two central waste terminals are proposed to be located on park lands to be conveyed to the City. No land lease costs have been carried as a result. While a large portion of these terminals can be located below ground, and the above grade components can be integrated into the park design, there will be a potential impact to the park design depending on its intended use.. A more detailed analysis is required to review options for mitigating this impact. Depending on the extent of mitigation desired, this mitigation may impact the central waste terminal costs carried.
- A comparison of Total BAU Capital Costs (City, Builder, Condo Corp) vs. AVAC Capital Costs shows a significant capital cost difference (ie \$18M vs. \$32M), which is expected
- A comparison of Total BAU Yearly Operational Costs (City, Builder, Condo Corp) vs. AVAC Yearly Operational Costs shows that the Operational Costs of the AVAC system for Langstaff is anticipated to be approximately 6% higher than BAU at full buildout.(ie \$1.26M/year vs \$1.34M/year)

### Revenues

- For this financial analysis, it has been assumed that building connection fees and end user rates would be charged by the City based on Business-As-Usual costs incurred by these parties.
  - A building connection fee amounting to approximately \$700 per residential unit, \$3.20 per commercial ft sq GFA, and \$1.48 per office ft sq GFA was calculated based on an estimated waste storage space savings by each of these landuses. The space savings was discounted to recognize that City staff would require larger bulk good storage space be provided in each building under AVAC than that under BAU. It should be noted that there is little industry precedent for establishing costs attributed to waste room space savings under AVAC, and as a result these fees would be subject to the Langstaff Builder buy-in.
  - A Condo Corporation fee of \$22/unit/year was established, based on an estimated savings related to bin jockeying and bin cleaning/maintenance/replacement.
  - A Producer Responsible Organization fee of \$6.50/unit/year was established based on BAU collection rates for residential recyclables. This fee represents a discount of 50% from BAU rates to account for uncertainty regarding this process.

- The phasing plan supplied by the City provides for an equal distribution of 365 residential units developed per year for the first 13 years, 243 residential units developed per year over the following 15 years, and 423 residential units developed per year for the final 15 years over a total of 43 years of buildout. Building connection fees, based on builder BAU costs comprise a significant portion of the system revenues. With too few units/year spread out over so many years, it will take **40 years** before revenues start to exceed expenses.
- Over the 43 year build-out period, total revenues amount to approximately **\$39.6M**

#### Gap

- Assuming revenues from the City, Producer Responsibility Organization, Builders, and Condo Corporations are based on BAU costs (ie what they would incur under business-as-usual conditions), there are not sufficient revenues generated to cover the Capital and Operational Costs
- Over the development build-out period of 43 years a gap of approximately **\$32.8M** results.

## 5 CONCLUSIONS

While it is anticipated that the AVAC System will provide the residents and employees within Langstaff with a better level of service and many environmental and social benefits, for the project to be financially viable, the gap of **\$32.8M** will need to be bridged. This could be achieved over the 43 year build-out through:

- Federal/Provincial Grants and Low Interest Funding
- An increase in End User Fees charged to the Residential Condo Corporations from \$22/unit/year to \$125/unit/year
- An increase in Residential Builder Connection Fees from \$700 per unit to \$2,100 per unit. Of the \$2,100 connection fee, \$700 represents the estimated cost savings to the developer and \$1,400 represents a premium payment to facilitate implementation of the system. Likewise the commercial builder connection fee would increase from \$3.20 per sq ft. to \$9.60 per sq ft. and the office builder connection fee would increase from \$1.48 per sq ft. to \$4.44 per sq ft.
- A City wide tax increase of \$750,000/year which results in a 0.46% tax increase.
- A combination of increased End User Fees, Builder Connection Fees and Government Grants and Taxes

The feasibility of this gap being bridged will be determined by the interest of and perceived benefits to the various stakeholders.

*Note: This analysis is based on cost estimates provided by the AVAC suppliers assuming the approved development buildout phasing associated with the approved Langstaff Gateway Planning District Secondary Plan. Changes to the development density and phasing will impact the capital costs, operational costs, and analysis conclusions.*

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## 6 REFERENCES

Envac Capital and Operational cost estimates dated June 2021

Photos and graphics courtesy of Envac AB



## *APPENDIX A*

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### *Langstaff Financial Model*

Langstaff- Vacuum Waste  
Cash Flow

## 2021 City Owned Utility Model

Note: Terminal, piping/ infrastructure within right-of-way, private/public building connections and inlets, parks self emptying waste bins, are all to be owned, operated, and maintained by the City

### Data Input/Assumptions

|   |           |  |
|---|-----------|--|
| City Owned and Operated System          |           |  |
| #Residential units in Langstaff-Revenue | 15,000    | # of Units currently approved within Langstaff Village                               |
| Non-Residential Retail and Commercial   | 746,000   | sq feet  |
| Non-Residential Office                  | 2,401,967 | sq feet  |
| Cardboard Fraction Included?            | NO        |  |
| Land for Terminal Building              | \$ -      | Assumed Waste Terminals to be located on City lands (below ground within City parks) |

|                     | Res. Units | Commercial GFA ft2 | Office GFA ft2 |
|---------------------|------------|--------------------|----------------|
| Phase 1 (2021-2035) | 5000       | 232500             | 361667         |
| Phase 2 (2036-2050) | 3650       | 218500             | 1430300        |
| Phase 3 (2036-2050) | 6350       | 295000             | 610000         |
|                     | 15000      | 746000             | 2401967        |

|   | Total Cost    | Unit Cost |   |
|---|---------------|-----------|---|
| Public Pipe Network (Entire Community)                | \$ 3,013,500  |           | Including 20% Contingency. Built 2022                                       |
| Terminal Buildings (East and West)                    | \$ 17,244,000 |           | Including 20% Contingency. Built 2022/2023                                  |
| Building Connections (Vokes per building)             | \$ 7,524,000  | \$114,000 | Including 20% Contingency. Built incrementally as buildings are constructed |
| Building Courtyard Self-Empowering Litter Bins        | \$ 3,960,000  | \$60,000  | Including 20% Contingency. Built incrementally as buildings are constructed |
| Public Self-Empowering Litter Bins in Parks (per bin) | \$ 476,400    | \$17,644  | Including 20% Contingency. Built incrementally as parks are constructed     |
|   | \$ 32,219,000 |           |   |

|   |    |      |   |
|---|----|------|---|
| City Contribution/Rebate per unit based on BAU      | \$ | 40   | Per unit per year up to and including 2025  |
| City Contribution/Rebate per unit based on BAU      | \$ | 27   | Per unit per year post 2025 (Total \$40/year reduced to reflect Producer component)                                   |
| Producer Contribution per unit based on BAU         | \$ | 6.3  | Per unit per year for Recyclables post 2025 (\$13/year discounted by 50% to reflect risk of reduced Producer payment) |
| Unit fund fee for system operation                  | \$ | 22   | Unit per year, assumed uniform for all units  |
| Residential bin connection fee - Commercial         | \$ | 700  | Per Unit connection fee calculated based on cost of bin storage space saved   |
| Non-residential builder connection fee - Commercial | \$ | 320  | Per sq foot connection fee calculated based on cost of bin storage space saved  |
| Non-residential builder connection fee - Office     | \$ | 1.48 | Per sq foot connection fee calculated based on cost of bin storage space saved  |

|   |              |   |
|---|--------------|---|
| Builder Pays for Residential Bld. Connects          | \$ 10,500.00 |   |
| Builder Pays for Non-Res Bld. Connects - Commercial | \$ 2,386.806 |   |
| Builder Pays for Non-Res Bld. Connects - Office     | \$ 3,546.934 |   |
| City Pays for Parks Connection Fee                  | \$ 250.00    | Connection fee equivalent to BAU Capital Cost for Waste Bins                                    |
| City Pays for Operational Costs (parks)             | \$ 40.00     | Operation Fee based on BAU of \$40,000 /year to collect park waste in Langstaff                 |
| Non-Residential Waste Collection Fees               | \$ 0.0436    | \$0.10 sq ft per year reduced to reflect the \$39 per lift is attributed to disposal/processing |

|                               |      |  |
|-------------------------------|------|--|
| FCM Low Interest Loan         | \$ - | for Terminal and Piping within ROW. Assumed 3% low interest rate to be paid back over 25 years |
| FCM Grant (up to 15% of Loan) | \$ - | (10% of Loan with \$1.5M-\$2M limit indicated by FCM)  |
| FCM Interest Rate (%)         | 3%   |  |
| FCM Payment Period            | 25   | years  |

Funding Gap - Revenue Source to be Determined

NPV Discount Rate 0% Rate of Return (interest rate)

[illegible]

| Year | 0    | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13   | 14   | 15   | 16   | 17   | 18   | 19   | 20   | 21   | 22   | 23   | 24   | 25   | 26   | 27   | 28   | 29   | 30   | 31   |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Item | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 |

[illegible]

### SYSTEM OPERATIONAL COSTS

[illegible]

FCM Loan Repayment based on 25 year term starting 2027 (year 5)

[illegible]**TOTAL COSTS**

## REVENUES

[illegible]

Funding Gap - Revenue Source to be Determined

**TOTAL REVENUES PER YEAR**

## NET PROFIT (Cashflow)

### CONSTRUCTIVE FEEDBACK

Present Value (PV)

Cumulative Value (NPV)

## Cumulative Unit Owner

**NPV at Year 30**

Over 44 year period

|                |                 |             |             |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |                |
|----------------|-----------------|-------------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|----------------|
| User based fee | \$32,920,842.44 | \$39,634.52 | \$79,269.04 | \$118,903.55 | \$158,538.07 | \$198,172.59 | \$237,807.11 | \$277,441.63 | \$317,076.14 | \$356,710.66 | \$396,345.18 | \$435,979.70 | \$475,614.22 | \$515,248.73 | \$540,264.81 | \$565,280.88 | \$590,296.95 | \$615,313.02 | \$640,329.10 | \$665,345.17 | \$690,361.24 | \$715,377.31 | \$740,393.39 | \$765,409.46 | \$790,425.53 | \$815,441.60 | \$840,457.68 | \$865,473.75 | \$890,489.82 | \$934,036.32 | \$977,582.81 | \$1,021,129.31 |
|----------------|-----------------|-------------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|----------------|

366 per equivalent unit  
included both res and non-res units:

| 2054  | 2055  | 2056  | 2057  | 2058  | 2059  | 2060  | 2061  | 2062  | 2063  | 2064  | 2065  |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 423   | 423   | 423   | 423   | 423   | 423   | 423   | 423   | 423   | 423   | 423   | 423   |
| 19667 | 19667 | 19667 | 19667 | 19667 | 19667 | 19667 | 19667 | 19667 | 19667 | 19667 | 19652 |
| 40667 | 40667 | 40667 | 40667 | 40667 | 40667 | 40667 | 40667 | 40667 | 40667 | 40667 | 40661 |
| 1.33  | 1.33  | 1.33  | 1.33  | 1.33  | 1.33  | 1.33  | 1.33  | 1.33  | 1.33  | 1.33  | 1.33  |
| 1.33  | 1.33  | 1.33  | 1.33  | 1.33  | 1.33  | 1.33  | 1.33  | 1.33  | 1.33  | 1.33  | 1.33  |

| 32   | 33   | 34   | 35   | 36   | 37   | 38   | 39   | 40   | 41   | 42   | 43   |
|------|------|------|------|------|------|------|------|------|------|------|------|
| 2054 | 2055 | 2056 | 2057 | 2058 | 2059 | 2060 | 2061 | 2062 | 2063 | 2064 | 2065 |

|            |            |            |            |            |            |            |            |            |            |            |            |
|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| \$ 152,000 | \$ 152,000 | \$ 152,000 | \$ 152,000 | \$ 152,000 | \$ 152,000 | \$ 152,000 | \$ 152,000 | \$ 152,000 | \$ 152,000 | \$ 152,000 | \$ 152,000 |
| \$ 80,000  | \$ 80,000  | \$ 80,000  | \$ 80,000  | \$ 80,000  | \$ 80,000  | \$ 80,000  | \$ 80,000  | \$ 80,000  | \$ 80,000  | \$ 80,000  | \$ 80,000  |
| \$ -       | \$ -       | \$ -       | \$ -       | \$ -       | \$ -       | \$ -       | \$ -       | \$ -       | \$ -       | \$ -       | \$ -       |

|               |               |               |               |               |               |               |               |               |               |               |               |
|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| \$ 120,000.00 | \$ 120,000.00 | \$ 120,000.00 | \$ 120,000.00 | \$ 120,000.00 | \$ 120,000.00 | \$ 120,000.00 | \$ 120,000.00 | \$ 120,000.00 | \$ 120,000.00 | \$ 120,000.00 | \$ 120,000.00 |
| \$ 270,000.00 | \$ 270,000.00 | \$ 270,000.00 | \$ 270,000.00 | \$ 270,000.00 | \$ 270,000.00 | \$ 270,000.00 | \$ 270,000.00 | \$ 270,000.00 | \$ 270,000.00 | \$ 270,000.00 | \$ 270,000.00 |
| \$ 165,472.00 | \$ 172,240.00 | \$ 179,008.00 | \$ 185,776.00 | \$ 192,544.00 | \$ 199,312.00 | \$ 206,080.00 | \$ 212,848.00 | \$ 219,616.00 | \$ 226,384.00 | \$ 233,152.00 | \$ 240,000.00 |
| \$ 300,000.00 | \$ 300,000.00 | \$ 300,000.00 | \$ 300,000.00 | \$ 300,000.00 | \$ 300,000.00 | \$ 300,000.00 | \$ 300,000.00 | \$ 300,000.00 | \$ 300,000.00 | \$ 300,000.00 | \$ 300,000.00 |
| \$ 280,612.93 | \$ 292,090.33 | \$ 303,567.73 | \$ 315,045.13 | \$ 326,522.53 | \$ 337,999.93 | \$ 349,477.33 | \$ 360,954.73 | \$ 372,432.13 | \$ 383,909.53 | \$ 395,386.93 | \$ 407,000.00 |

|              |              |              |              |              |              |              |              |              |              |              |              |
|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| \$ 1,368,085 | \$ 1,386,330 | \$ 1,404,576 | \$ 1,422,821 | \$ 1,441,067 | \$ 1,459,312 | \$ 1,477,557 | \$ 1,495,803 | \$ 1,514,048 | \$ 1,532,294 | \$ 1,550,539 | \$ 1,569,000 |
|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|

|               |               |               |               |               |               |               |               |               |               |               |               |
|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| \$ 294,249    | \$ 305,670    | \$ 317,091    | \$ 328,512    | \$ 339,933    | \$ 351,354    | \$ 362,775    | \$ 374,196    | \$ 385,617    | \$ 397,038    | \$ 408,459    | \$ 420,015    |
| \$ 67,223     | \$ 69,973     | \$ 72,722     | \$ 75,472     | \$ 78,221     | \$ 80,971     | \$ 83,720     | \$ 86,470     | \$ 89,219     | \$ 91,969     | \$ 94,718     | \$ 97,500     |
| \$ 227,550    | \$ 236,857    | \$ 246,164    | \$ 255,471    | \$ 264,779    | \$ 274,086    | \$ 283,393    | \$ 292,700    | \$ 302,007    | \$ 311,314    | \$ 320,621    | \$ 330,038    |
| \$ 296,100    | \$ 296,100    | \$ 296,100    | \$ 296,100    | \$ 296,100    | \$ 296,100    | \$ 296,100    | \$ 296,100    | \$ 296,100    | \$ 296,100    | \$ 296,100    | \$ 299,600    |
| \$ 62,904     | \$ 62,904     | \$ 62,904     | \$ 62,904     | \$ 62,904     | \$ 62,904     | \$ 62,904     | \$ 62,904     | \$ 62,904     | \$ 62,904     | \$ 62,904     | \$ 62,876     |
| \$ 60,052     | \$ 60,052     | \$ 60,052     | \$ 60,052     | \$ 60,052     | \$ 60,052     | \$ 60,052     | \$ 60,052     | \$ 60,052     | \$ 60,052     | \$ 60,052     | \$ 60,043     |
| \$ -          | \$ -          | \$ -          | \$ -          | \$ -          | \$ -          | \$ -          | \$ -          | \$ -          | \$ -          | \$ -          | \$ -          |
| \$ 40,000     | \$ 40,000     | \$ 40,000     | \$ 40,000     | \$ 40,000     | \$ 40,000     | \$ 40,000     | \$ 40,000     | \$ 40,000     | \$ 40,000     | \$ 40,000     | \$ 40,000     |
| \$ 108,290.61 | \$ 110,920.55 | \$ 113,550.50 | \$ 116,180.44 | \$ 118,810.38 | \$ 121,440.33 | \$ 124,070.27 | \$ 126,700.22 | \$ 129,330.16 | \$ 131,960.10 | \$ 134,590.05 | \$ 137,219.07 |

|              |              |              |              |              |              |              |              |              |              |              |              |
|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| \$ 1,156,389 | \$ 1,182,496 | \$ 1,208,604 | \$ 1,234,712 | \$ 1,260,819 | \$ 1,286,927 | \$ 1,313,034 | \$ 1,339,142 | \$ 1,365,249 | \$ 1,391,357 | \$ 1,417,464 | \$ 1,447,291 |
|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|

|                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| \$ (211,696)    | \$ (203,834)    | \$ (195,972)    | \$ (188,110)    | \$ (180,247)    | \$ (172,385)    | \$ (164,523)    | \$ (156,661)    | \$ (148,799)    | \$ (140,937)    | \$ (133,075)    | \$ (121,709)    |
| \$ (31,004,885) | \$ (31,208,718) | \$ (31,404,690) | \$ (31,592,800) | \$ (31,773,047) | \$ (31,945,433) | \$ (32,109,956) | \$ (32,266,617) | \$ (32,415,416) | \$ (32,556,353) | \$ (32,689,428) | \$ (32,811,136) |

|                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| \$ (211,696)    | \$ (203,834)    | \$ (195,972)    | \$ (188,110)    | \$ (180,247)    | \$ (172,385)    | \$ (164,523)    | \$ (156,661)    | \$ (148,799)    | \$ (140,937)    | \$ (133,075)    | \$ (121,709)    |
| \$ (31,004,885) | \$ (31,208,718) | \$ (31,404,690) | \$ (31,592,800) | \$ (31,773,047) | \$ (31,945,433) | \$ (32,109,956) | \$ (32,266,617) | \$ (32,415,416) | \$ (32,556,353) | \$ (32,689,428) | \$ (32,811,136) |
| Year 33         | Year 34         | Year 35         | Year 36         | Year 37         | Year 38         | Year 39         | Year 40         | Year 41         | Year 42         | Year 43         | Year 44         |

|              |              |              |              |              |              |              |              |              |              |              |              |
|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| \$ 3,918,652 | \$ 4,155,509 | \$ 4,401,674 | \$ 4,657,145 | \$ 4,921,924 | \$ 5,196,009 | \$ 5,479,402 | \$ 5,772,102 | \$ 6,074,109 | \$ 6,385,422 | \$ 6,706,043 | \$ 7,036,081 |
|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|

|                |                |                |                |                |                |                |                |                |                |                |                |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| \$ 750,000     | \$ 750,000     | \$ 750,000     | \$ 750,000     | \$ 750,000     | \$ 750,000     | \$ 750,000     | \$ 750,000     | \$ 750,000     | \$ 750,000     | \$ 750,000     | \$ 750,000     |
| \$1,064,675.81 | \$1,108,222.30 | \$1,151,768.80 | \$1,195,315.29 | \$1,238,861.79 | \$1,282,408.29 | \$1,325,954.78 | \$1,369,501.28 | \$1,413,047.78 | \$1,456,594.27 | \$1,500,140.77 | \$1,544,202.00 |