Annex C

FLEET REPLACEMENT PLAN

for the

CITY OF PRINCE GEORGE

July, 2014

MERCURY ASSOCIATES, INC.
# TABLE OF CONTENTS

FLEET REPLACEMENT PRACTICES AND FINANCING OPTIONS ........................................ 1

PRINCIPLES OF EFFECTIVE FLEET REPLACEMENT ........................................ 1
  Determination of Optimal Vehicle Replacement Cycles ......................................... 2
  Replacement Planning ......................................................................................... 3
  Replacement Funding ......................................................................................... 4
  Replacement Prioritization .................................................................................. 5

FINDINGS .............................................................................................................. 6
  Optimal Vehicle Replacement Cycles .................................................................... 6

REPLACEMENT CYCLE ANALYSIS RESULTS ....................................................... 8
  Optimal Replacement Cycle Analysis Results – Dump Trucks ................................ 11
  Target and Actual Replacement Cycles .................................................................. 14
  Fleet Replacement Planning and Costs ................................................................. 15

Financing Fleet Replacement Costs ......................................................................... 19
  Outright Purchase with Ad Hoc Appropriations of Cash ....................................... 20
  Sinking Fund and Charge-Back System ................................................................ 21
  Debt Financing and Leasing ................................................................................ 22
  Replacement Financing Options ........................................................................... 23
  Outright Cash Purchase ....................................................................................... 24
  Replacement Reserve Fund ................................................................................ 24
  Loan Financing ................................................................................................ 26

CONCLUSIONS .................................................................................................... 29

RECOMMENDATIONS ......................................................................................... 29
FLEET REPLACEMENT PRACTICES AND FINANCING OPTIONS

This section of our report presents the results of Mercury Associates’ assessment of fleet replacement practices employed by the City of Prince George (CPG). Specific areas included in this analysis are:

- Determining optimal replacement cycles for selected types of assets in the City’s fleet;
- Determining the long-term replacement costs of the fleet; and
- Modeling the costs of various alternative financing approaches.

PRINCIPLES OF EFFECTIVE FLEET REPLACEMENT

An effective fleet replacement program is essential for controlling fleet performance (i.e., vehicle suitability, availability, reliability, safety, and environmental impacts) and total cost of ownership.

Before discussing our evaluation of CPG’s fleet replacement practices and recommendations for improving them, it is useful to review the major components of an effective fleet replacement program, as they provide the philosophical and analytical framework that our project team used as the point of departure for conducting this evaluation.

There are five key components of an effective fleet replacement program. They are:

1. Empirically validated vehicle replacement cycle guidelines that identify when specific types of fleet assets generally should be replaced to minimize their life cycle costs (i.e., total cost of ownership).
2. A long-term fleet replacement plan that pinpoints anticipated replacement dates and costs of individual assets based on the application of recommended replacement cycles and quantifies year-to-year, fleet-wide replacement costs and future variations therein.
3. A capital financing approach that facilitates securing sufficient funds each year to acquire replacement vehicles by making such funding requirements smooth, predictable, and, to the fullest extent possible, invulnerable to competition from other competing capital funding requests.
4. A short-term replacement prioritization and earmarking process for designating specific vehicles and pieces of equipment to be replaced in the coming fiscal year.
5. A budgeting and funding process that enables fleet user organizations to secure the amount of funds needed each year to execute the replacement plan based on the selected financing approach.
Determination of Optimal Vehicle Replacement Cycles

Vehicle replacement guidelines should be based on the economic theory of optimal vehicle replacement, which is illustrated graphically here. As a vehicle ages, its capital cost diminishes and its operating costs (e.g., maintenance, repair, and fuel) increase. The combination of these two costs produces a U-shaped total cost curve that reflects the total cost of ownership of the asset. Ideally, a vehicle or piece of equipment should be replaced around the time the rise in annual operating costs begin to outweigh the decline in annual capital costs – that is, when the two cost curves intersect and the total cost of ownership begins to increase.

The total cost curve is different for every type of vehicle and, indeed, for every individual vehicle of a given type. This variability is caused by differences in the design and engineering of different types of vehicles, in operating environments, in the quality of care vehicles receive, and a variety of other factors. In recognition of this fact, most organizations develop recommended replacement cycles for a class or type of vehicles, which will approximate the optimal replacement cycle for most of the units in that particular class. Historically this was most often accomplished in an informal manner based on discussions with mechanics and drivers, and a comparison of replacement cycles with peer organizations.

Best practice fleet organizations develop these cycles empirically using optimal replacement cycle analysis techniques. This analytical approach involves modeling the stream of costs associated with acquiring, operating, and disposing of a particular type of vehicle or piece of equipment over a range of potential ages or replacement cycles, and identifying the cycle that will result in the lowest total cost of ownership. The simplest way to identify this cycle is with a metric called equivalent annual cost (EAC).

What is most important about an empirical approach to determining optimal vehicle replacement cycles is that it provides the foundation for planning and making replacement decisions based on objective information as opposed to opinion, subjective judgment, or past practice. In our experience, even the best-educated or well-intentioned individuals in an organization may believe cost savings or avoidance opportunities exist where they do not, in fact, exist. Moreover, biases against a particular replacement philosophy or approach may lead some stakeholders to promote suboptimal strategies or decisions. For example, fleet maintenance supervisors are aware of the impact that replacement decisions can have on their garage staff. Changing cycles in a way that would significantly decrease the amount of maintenance...
work required may color the way they view such options. In the absence of hard data, it is not difficult to make almost any approach sound more cost effective.

Optimal replacement cycle analyses are valuable for examining the “hard” capital and operating costs associated with alternative replacement cycles for a given type of vehicle. It is important to note, however, that there often are other costs, some more easily measured than others, which are also impacted by an organization’s replacement cycle decisions. These include items such as:

- Unmanageability of repair costs
- Increasing vehicle downtime and its impact on fleet size
- Service disruptions
- Reduced employee productivity
- Reduced employee safety
- Reduced public safety
- Higher greenhouse gas emissions

Decision makers who assume that cutting replacement purchases is a good way to help balance the budget need to understand that such cuts typically just transfer fleet costs from the capital to the operating side of the general ledger, actually increasing the total cost of ownership of a the fleet in the process. Regardless of its net effect on current fleet costs, the deferral of replacement purchases on a regular basis unquestionably leads to an older fleet with significant downtime at best, and at worst, the inability to provide services due to unreliable transportation. Delaying replacement increases future replacement spending needs, often resulting in growing and increasingly unmanageable fleet replacement backlogs.

**Replacement Planning**

Item 2 from the list of effective fleet replacement program components calls for a long-term fleet replacement plan that projects future vehicle replacement dates and purchase costs associated with the use of a stated set of replacement cycles. It quantifies year-to-year, fleet-wide replacement costs and future variations therein, allowing for effective long-term planning and budgeting.

A key benefit of a long-term replacement plan is its ability to help fleet managers educate decision makers as to the magnitude of fleet replacement costs and the inherent annual peaks and valleys in such costs over time. It specifically helps fleet management organizations and their customers address two misconceptions held by many nonprofessionals that often are major factors behind an organization’s failure to devote enough funds to fleet replacement, which is the primary impediment to, in turn, replacing vehicles and equipment in a timely manner.
One of these misconceptions is the belief that fleet replacement costs are quasi
discretionary and that there is no compelling reason to fill 100 percent of the requests
for fleet replacement funds that line organizations make each year. The other is the
belief that it is not necessary to vary to any significant degree the amount of funds
devoted to fleet replacement spending from year to year.

A good fleet replacement planning process not only quantifies the costs of replacing the
fleet over the long term so that management and budget decision makers can see that
this is a significant, recurring cost of doing business. It also illustrates the consequences
of under-funding replacement expenditures by translating spending shortfalls into future
spikes in, and backlogs of, replacement spending needs.

Replacement Funding

Items 3 and 5 from the list of essential elements of an effective replacement program
pertain to the manner in which an organization finances fleet replacement (i.e., vehicle
and equipment acquisition) costs. The best fleet replacement plans are of no value
without the annual funding required to implement them.

As an example, the chart below shows the annual replacement costs over a period of
20 years of a government fleet of about 600 vehicles and pieces of equipment.

---

1 This fleet is used for illustrative purposes only but is consistent with most governmental fleet operations.
As can be seen, year-to-year fleet replacement spending requirements are quite volatile with peaks and valleys of varying magnitude occurring routinely throughout the 20-year period. The first year is very high, reflecting a backlog of vehicles requiring replacement. This unevenness is common in virtually all mixed-vocational fleets.

Even during good economic times, securing sufficient funds to replace vehicles and equipment in a timely manner is a challenge for many organizations. In our experience, the vulnerability of fleet replacement funding in most organizations stems less from a lack of appreciation of the importance of vehicles or of the need to replace them on a regular basis, and more from a lack of willingness to commit sufficient funds to fleet replacement. This reluctance is greatly impacted by the large numbers of vehicles that may need to be replaced in some years and the inability of certain capital financing approaches to effectively deal with the resulting replacement spending needs that are inherently uneven from year to year.

Most organizations, particularly in the public sector, do not have a good mechanism for accommodating year-to-year changes in spending requirements when the source of funds (i.e. tax revenues) for such expenditures is relatively static. The solution to this problem lies in pursuing one of two courses of action: eliminating the volatility in fleet replacement spending requirements, or eliminating the volatility in replacement funding requirements. While annual volatility in the replacement cost of a fleet (i.e., spending requirements) can be managed to a certain extent over the short term – say three to five years – it cannot be completely eliminated in a fleet comprised of many different types of vehicles. The year-over-year volatility of replacement funding requirements, on the other hand, can be managed quite well, depending on the method used to finance fleet replacement costs.

**Replacement Prioritization**

Item 4 from the list of effective fleet replacement program requirements indicates the need for a short-term replacement prioritization and earmarking process for designating specific vehicles and pieces of equipment to be replaced in the coming fiscal year. This process takes us from the data-driven model of a long-term fleet replacement plan, to the real-world review of vehicles proposed to be replaced in a given year.

Because a fleet replacement plan and the replacement cycle guidelines for different types of vehicles on which it is based derive from cost and other information for the “average” or “typical” vehicle or piece of equipment of each type, they do not fully take into account the unique characteristics of each asset in a fleet. The long-term replacement plan should serve to identify which assets are candidates for replacement each year, not which assets will definitely be replaced each year. These candidates should be scrutinized using criteria that are not limited to age and life-to-date kilometers or hours of use.

A replacement prioritization process includes reviewing a vehicle’s application and use to determine if it will be required long term. It also reviews the application and condition...
of the vehicle, identifies the type of replacement unit required and prioritizes vehicles on
the replacement list for use in order/delivery cycling. Best practice organizations use a
scoring system to set priorities. The system incorporates values for factors or attributes
that are unique to each vehicle, including current utilization level; front-line or backup
assignment status; recent repair history and pending repair/refurbishment costs;
perceived reliability, suitability, and safety; and ease of replacement.

FINDINGS

Optimal Vehicle Replacement Cycles

Earlier in this report we outlined the principles of effective fleet replacement and
empirically validated replacement cycles. We explained that the industry best practice is
to develop these cycles empirically using life cycle cost analysis (LCA) techniques. This
approach involves modeling the stream of costs associated with acquiring, operating,
and maintaining and repairing a particular type of vehicle or piece of equipment over a
range of potential ages or replacement cycles, and then determining the cycle that will
result in the lowest total cost of ownership.

A key metric we use in determining optimal replacement cycles is equivalent annual
cost (EAC). The EAC of a capital asset is a uniform dollar amount, the net present value
of whose payments for a given period of time (i.e., replacement cycle) is equivalent to
the net present value costs of owning and operating that asset over the course of that
period. It is a useful metric for comparing the costs of alternative replacement cycles
(i.e., streams of future costs of different durations) for an asset in order to determine
which cycle results in the lowest total cost of ownership.

While the analysis of objective data is essential for identifying optimal replacement
cycles, it is important to note that there also are indirect asset costs which are impacted
by an organization’s vehicle replacement policies and decisions, and that may not be
easy to quantify but nonetheless should be taken into account when reviewing and
interpreting empirical analysis results. These factors include:

- The predictability and, hence, manageability of asset repair costs, both of which tend
to diminish as assets age;
- Maintenance and repair-related asset downtime and its impact on fleet size;
- Service disruptions resulting from unexpected asset breakdowns;
- Impacts on employee efficiency, productivity, effectiveness, and safety associated
  with asset availability and reliability levels;
- Reduced driver/operator confidence in and satisfaction with asset performance, and
corresponding changes in asset usage decisions and practices; and
- Technological obsolescence which impacts everything from repair parts availability
to fuel consumption rates.
In consultation with Fleet Services, we selected 4 types of vehicles for inclusion in the optimal replacement cycle analysis component of this study: dump trucks, loaders, graders, and sidewalk snow machines. The number of each type of unit in the fleet is shown in Figure 2. Furthermore, the results of our analyses can be applied to other similar classes of assets in the fleet that, in our experience, would produce similar LCA results. For example, the results of our analysis of the optimal replacement cycle for dump trucks can safely be applied to other sizes of heavy duty trucks in the absence of analyses of the life cycle costs of the latter.

**Figure 1**
Asset Types Included in Replacement Cycle Analysis and Quantities of Each

<table>
<thead>
<tr>
<th>Asset Type</th>
<th>Number of Units</th>
<th>Model Chosen for Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dump Truck</td>
<td>11</td>
<td>Sterling LT9500</td>
</tr>
<tr>
<td>Loader</td>
<td>5</td>
<td>Caterpillar Loader 938G SII</td>
</tr>
<tr>
<td>Grader</td>
<td>5</td>
<td>Caterpillar 160H Grader</td>
</tr>
<tr>
<td>Sidewalk Snow Machine</td>
<td>5</td>
<td>MT 6 Trackless</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>26</strong></td>
<td></td>
</tr>
</tbody>
</table>

We selected specific elements of historical data for each asset of each type included in our analysis. These data items pertained to the principal direct costs associated with owning and operating each of the asset types such as original purchase prices and in-service dates; and miles driven and maintenance, repair, and fuel costs for the past year.

The types of information we assembled and the sources of each are shown in Figure 3.

**Figure 3**
Information Sources for Cost Modelling

<table>
<thead>
<tr>
<th>Data Required for Analysis</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fleet Inventory</td>
<td>City of Prince George</td>
</tr>
<tr>
<td>Original Purchase Prices</td>
<td>City of Prince George</td>
</tr>
<tr>
<td>Annual Asset Usage</td>
<td>City of Prince George</td>
</tr>
<tr>
<td>Asset Residual Values</td>
<td>CARCAP</td>
</tr>
<tr>
<td>Asset Maintenance and Repair Costs</td>
<td>New York State</td>
</tr>
<tr>
<td>Fuel Economy Rates (HPL)(^2)</td>
<td>City of Prince George</td>
</tr>
<tr>
<td>Fuel Prices</td>
<td>The World Bank website (worldbank.org)</td>
</tr>
<tr>
<td>Fuel Economy Deterioration Factor</td>
<td>U.S. EPA CAFE and work truck fuel</td>
</tr>
</tbody>
</table>

\(^2\) Hours per litre. All of the assets that were analyzed in this study had meters that were measured in hours which is why the metric for fuel economy is in hours per litre.
For each type of asset identified above, we conducted a life cycle cost analysis using a proprietary software program called ORCA™ developed by Mercury Associates for this purpose. We used this program to calculate the equivalent annual cost (EAC) associated with keeping each type of asset in service for periods ranging from 1 to as many as 20 years, and identified the replacement cycle that would result in the lowest EAC. We made a final replacement cycle recommendation based on review of the EAC calculations, especially relative differences (often small) between the EAC under the lowest-cost replacement cycle and under replacement cycles that are one or two years shorter or longer than it. We also took into account other “soft cost” considerations such as those discussed above (e.g., reliability, predictability of repair costs, parts availability, and technological obsolescence).

For each group of assets examined, we usually perform extensive statistical analysis of historical asset usage and maintenance and repair cost data in order to 1) determine the average annual level of usage during the primary period of use of each asset type during its service life; and 2) develop regression equations for estimating a) annual asset maintenance and repair costs, and b) end-of-year asset fair market values (FMV) as a function of changes in asset age (i.e., potential replacement cycle) and accumulated miles of use. However, due to Fleet Service’s fleet size and availability of historical data, this was not possible. Therefore, regression equations from another municipality with similar asset usage and types were used for the ORCA analysis.

We estimated fuel costs based on the fuel efficiency in hours per litre of each vehicle type, the 2012 City of Prince George region average cost per litre of fuel ($1.52 for gasoline and $1.39 for diesel) as reported by the World Bank Organization, and an annual fuel price inflation rate of 3 percent. We also included an annual fuel efficiency degradation factor of 1 percent to reflect the fact that assets become less fuel efficient as they age and the fact that keeping assets in a fleet for a long time deprives fleet owners of gains in new vehicle fuel efficiency made possible by advances in vehicle engineering and manufacturing required to comply with fuel economy standards.

REPLACEMENT CYCLE ANALYSIS RESULTS

The current average and optimal replacement cycle (in years) and the estimated operating cost savings for each type of asset included in our analysis are shown in Figure 4. The de facto replacement cycles of the assets that result (wittingly or unwittingly) from the City’s current and recent fleet replacement spending levels are considerably longer than the recommended cycles. The optimal replacement cycles we

3 The “current” replacement cycle was determined by developing a frequency distribution of the assets in each class by current asset age and “eyeballing” the results. If the current ages of all the assets in the class displayed a normal distribution, the current average replacement cycle would be double the current mean age of the assets. In a non-normal age distribution, typical in older fleets, doubling the current mean age of the assets tends to overstate the age at which most assets in a given class currently are being replaced.
identified in this study are similar to those we have found in numerous other studies of this type that we have performed for public-sector fleets over the last 15 years.

We estimate that the City could reduce the operating costs of all of the assets of these four types in its fleet by approximately $60,000 per year (in 2014 dollars) if it were to replace them in accordance with the recommended replacement cycles rather than the planned cycles identified here4. Cost savings could be further increased by applying the recommended replacement cycles to other similar classes of vehicles in the fleet. As can be seen in Figure 4, the largest differences between current and recommended cycles are for the dump truck class. Since this class of vehicles has the largest operating costs of the asset types analyzed, they account for the lion’s share of the potential cost savings shown. To err on the side of caution and not overstate the potential savings, the calculated savings were based on the planned replacement cycle rather than the actual replacement cycle used by the City.

4 Our estimation of annual cost savings from implementing the recommended replacement cycles is limited to asset operating costs because the capital cost values used in determining optimal replacement cycles are economic rather than fiscal impact (i.e., cash) values. It is of limited value to decision making to quantify asset capital cost savings from a change in replacement cycles without specifying how the capital costs are actually paid (financed). That said, the cost savings shown in Figure 4 would be reduced somewhat by the increase in asset capital costs that would result from the use of shorter replacement cycles.
Figure 2
Current and Recommended Replacement Cycles and Associated Annual Asset Operating Cost Savings
(Cost in 2014 dollars)

<table>
<thead>
<tr>
<th>Asset Type</th>
<th>Number of Units</th>
<th>Current Average Age (years)</th>
<th>Planned Replacement Cycle</th>
<th>Current Replacement Cycle (years)</th>
<th>Recommended Replacement Cycle (Years)</th>
<th>Avg. Annual Operating Cost Under Planned Cycle</th>
<th>Avg. Annual Operating Cost Under Recomm. Cycle</th>
<th>Avg. Annual Operating Cost Savings per Vehicle</th>
<th>Annual Operating Cost Savings</th>
<th>Total Avg. Annual Operating Cost Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dump Truck</td>
<td>11</td>
<td>9.3</td>
<td>10</td>
<td>18.6</td>
<td>7</td>
<td>$50,881</td>
<td>$41,918</td>
<td>$8,963</td>
<td>18%</td>
<td>$98,589</td>
</tr>
<tr>
<td>Loader</td>
<td>5</td>
<td>8</td>
<td>10</td>
<td>10</td>
<td>15</td>
<td>$44,480</td>
<td>$49,893</td>
<td>($5,413)</td>
<td>-12%</td>
<td>($27,063)</td>
</tr>
<tr>
<td>Grader</td>
<td>5</td>
<td>6.8</td>
<td>10</td>
<td>10</td>
<td>12</td>
<td>$42,533</td>
<td>$44,521</td>
<td>($1,988)</td>
<td>-5%</td>
<td>($9,938)</td>
</tr>
<tr>
<td>Sidewalk Snow Machine</td>
<td>5</td>
<td>8</td>
<td>9</td>
<td>16</td>
<td>10</td>
<td>$9,475</td>
<td>$9,742</td>
<td>($267)</td>
<td>-3%</td>
<td>($1,333)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>26</strong></td>
<td><strong>8</strong></td>
<td><strong>10</strong></td>
<td><strong>14</strong></td>
<td><strong>11</strong></td>
<td><strong>$36,842</strong></td>
<td><strong>$36,519</strong></td>
<td><strong>$324</strong></td>
<td><strong>-1%</strong></td>
<td><strong>$60,255</strong></td>
</tr>
</tbody>
</table>

5 Models in general are used to validate expert judgment. When limited data is available, even the best models do not perform as expected, such as the case of the other 3 classes of assets: Loaders, Graders, Sidewalk Snowmachines. There is half of the number of these asset types compared to the data available from the 11 dump trucks. Therefore, we relied on expert judgment to determine the optimal replacement cycles for the 3 assets previously mentioned; however, the model output is shown here for reference.

6 In the case of the grader and sidewalk snow machine there is not much difference in the savings between the planned replacement year versus the recommended replacement year. We feel that extending the replacement cycle of these assets is more practical for the City of Prince George at this time.
Below are the details of our optimal replacement cycle analysis for one of the four types of assets: dump trucks. Details for the remaining classes of assets can be found in the appendix to this report.

**Optimal Replacement Cycle Analysis Results – Dump Trucks**

The key assumptions and inputs we used for the dump truck replacement cycle analysis included the following:

1. New vehicle purchase price: $270,000
2. Average annual usage (hours): 1,325
3. Fuel economy rate (HPL): .1
4. Fuel cost per litre: $1.39
5. Annual fuel efficiency degradation rate\(^7\): 1 percent
6. Annual inflation rate for M&R and fuel costs: 3 percent
7. Discount rate: 6 percent
8. Residual values by vehicle age and accumulated mileage, expressed as a percentage of current vehicle purchase price, obtained from an analysis in CARCAP.

City agencies currently keep dump trucks in service for up to 18 years. The average age of all the dump trucks currently in the fleet is 9.3 years, and the current planned replacement cycle appears is 10 years.

The results of our analysis, shown in Figure 5, indicate that these vehicles’ total cost of ownership (indicated by the equivalent annual cost – EAC – shown in the bottom row of the table) is, strictly speaking, at a minimum under a replacement cycle of 7 years.

Comparing the average annual operating cost of this type of vehicle under a 7-year cycle and the current 10-year cycle, it can be seen that the City would save an estimated $9,000 or 17 percent per vehicle per year by replacing these vehicles every 7 years. Based on the total number of dump trucks in the fleet, this translates into almost $98,000 in operating savings \textit{per year}. Since vehicle capital costs can vary substantially over time depending on the method used to finance them, it makes no sense to incorporate them in this average annual cost savings estimate. However, vehicle capital costs will be higher under the optimal replacement cycle, meaning that the aggregate net cost savings would be somewhat lower than this amount.

\(^7\) Per year of vehicle age.
On the other hand, it also should be noted that this savings amount does not include any of those indirect costs of aging vehicles noted earlier, notably the growing unpredictability of repair costs. For example, our life cycle cost analysis (Figure 5) shows that predicted annual maintenance and repair costs increase by more than $22,000 or approximately 80% between Age 7 and Age 10, with most, if not all, of this increase being attributable to increased repair requirements, which are generally unscheduled and thus cannot be performed as efficiently as can scheduled services.
**Figure 3**  
*Optimal Replacement Cycle Analysis for Dump Truck*

<table>
<thead>
<tr>
<th>Replacement Cycle (years)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year-End Odometer Reading (hrs)</td>
<td>1,325</td>
<td>2,650</td>
<td>3,975</td>
<td>5,300</td>
<td>6,625</td>
<td>7,950</td>
<td>9,275</td>
<td>10,600</td>
<td>11,925</td>
<td>13,250</td>
</tr>
<tr>
<td><strong>Capital Cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation Schedule</td>
<td>70.0%</td>
<td>58.5%</td>
<td>48.8%</td>
<td>40.8%</td>
<td>34.1%</td>
<td>28.5%</td>
<td>23.8%</td>
<td>19.9%</td>
<td>16.6%</td>
<td>13.9%</td>
</tr>
<tr>
<td>Capital Cost</td>
<td>$ 81,000</td>
<td>$ 31,134</td>
<td>$ 26,005</td>
<td>$ 21,721</td>
<td>$ 18,143</td>
<td>$ 15,155</td>
<td>$ 12,658</td>
<td>$ 10,573</td>
<td>$ 8,831</td>
<td>$ 7,376</td>
</tr>
<tr>
<td><strong>Operating Costs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual M&amp;R Cost</td>
<td>$ 7,984</td>
<td>$ 9,748</td>
<td>$ 11,901</td>
<td>$ 14,529</td>
<td>$ 17,738</td>
<td>$ 21,656</td>
<td>$ 26,439</td>
<td>$ 32,278</td>
<td>$ 39,407</td>
<td>$ 48,111</td>
</tr>
<tr>
<td>Annual Fuel Cost</td>
<td>$ 23,196</td>
<td>$ 24,133</td>
<td>$ 25,108</td>
<td>$ 26,123</td>
<td>$ 27,178</td>
<td>$ 28,276</td>
<td>$ 29,419</td>
<td>$ 30,607</td>
<td>$ 31,844</td>
<td>$ 33,131</td>
</tr>
<tr>
<td>Total Annual Operating Cost</td>
<td>$ 31,180</td>
<td>$ 33,881</td>
<td>$ 37,009</td>
<td>$ 40,652</td>
<td>$ 44,916</td>
<td>$ 49,932</td>
<td>$ 55,858</td>
<td>$ 62,886</td>
<td>$ 71,251</td>
<td>$ 81,242</td>
</tr>
<tr>
<td>Cumulative Operating Cost (2014$)</td>
<td>$ 31,180</td>
<td>$ 65,061</td>
<td>$102,070</td>
<td>$142,722</td>
<td>$187,638</td>
<td>$237,570</td>
<td>$293,428</td>
<td>$356,313</td>
<td>$427,564</td>
<td>$508,806</td>
</tr>
<tr>
<td>Avg Annual Operating Cost (2014$)</td>
<td>$ 31,180</td>
<td>$ 32,531</td>
<td>$ 34,023</td>
<td>$ 35,680</td>
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<td>$ 41,918</td>
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<td>$ 47,507</td>
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<tr>
<td><strong>Total Cost</strong></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Annual Total Cost</td>
<td>$112,180</td>
<td>$ 65,015</td>
<td>$ 63,014</td>
<td>$ 62,373</td>
<td>$ 63,059</td>
<td>$ 65,087</td>
<td>$ 68,516</td>
<td>$ 73,459</td>
<td>$ 80,083</td>
<td>$ 88,618</td>
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<tr>
<td>Cumulative Total Cost</td>
<td>$112,180</td>
<td>$177,195</td>
<td>$240,209</td>
<td>$302,582</td>
<td>$365,642</td>
<td>$430,728</td>
<td>$499,244</td>
<td>$572,703</td>
<td>$652,785</td>
<td>$741,403</td>
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<td>Equivalent Annual Cost</td>
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<td>$ 80,556</td>
<td>$ 76,210</td>
<td>$ 73,733</td>
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<td>$ 71,890</td>
<td>$ 72,066</td>
<td>$ 72,855</td>
<td>$ 74,230</td>
</tr>
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</table>
Target and Actual Replacement Cycles

The City has established replacement cycles based on age (years in service) and usage (kilometers or engine hours) for all vehicle and equipment classifications. They are based on historical experience, surveys of like organizations, and life cycle analysis performed in-house and as part of a 2009 consulting study.

In addition to performing optimal replacement cycle analyses for four specific vehicle and equipment types, as was discussed in the previous section of this report, we reviewed the City’s current replacement cycle guidelines for all other types of vehicles and equipment in the fleet. While we found most of these guidelines to be reasonable, we have recommended adjustments to some cycles, as summarized below. The changes are based on the condition of the fleet, operating environment, industry standards, and our experience with similar fleet organizations.

*Figure 4
Recommended Changes to Existing Replacement Cycles*

<table>
<thead>
<tr>
<th>Classification</th>
<th>Current Replacement Cycle (months)</th>
<th>Recommended Replacement Cycle (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pickup trucks, compact</td>
<td>72-120</td>
<td>96</td>
</tr>
<tr>
<td>Pickup trucks, ½-ton</td>
<td>96-120</td>
<td>96</td>
</tr>
<tr>
<td>Pickup trucks, ¾-ton</td>
<td>120</td>
<td>96</td>
</tr>
<tr>
<td>Dump trucks, HD</td>
<td>120</td>
<td>84*</td>
</tr>
<tr>
<td>Backhoes</td>
<td>60</td>
<td>144</td>
</tr>
<tr>
<td>Loaders</td>
<td>120</td>
<td>180*</td>
</tr>
<tr>
<td>Excavators</td>
<td>60</td>
<td>144</td>
</tr>
<tr>
<td>Graders</td>
<td>120</td>
<td>144*</td>
</tr>
<tr>
<td>Trailer mounted pumps</td>
<td>96</td>
<td>120</td>
</tr>
<tr>
<td>Wood chipper</td>
<td>96</td>
<td>120</td>
</tr>
<tr>
<td>Stump grinder</td>
<td>96</td>
<td>120</td>
</tr>
</tbody>
</table>

*Recommended replacement cycle as a result of the ORCA.

If the City were replacing its fleet assets in accordance with the replacement cycles we recommend it use, the weighted average cycle for all the different types of assets in the fleet would be 9.5 years. Assuming that the assets in a fleet are normally distributed by age, which is not unreasonable for a fleet of 315 units, their average age would be one-half of their average replacement cycle, or 4.75 years. However, as of June 1, 2014, the current average age of the fleet is 9.6. We can infer from this that the “de facto” average
replacement cycle for the assets in the fleet is two times 9.6, or 19.1 years. This is nearly double what we would expect it to be.

A fleet that is replaced regularly in accordance with reasonable replacement cycles would have a normal distribution of assets by model year. The bell-shaped density curve should be symmetrical, centered about its mean. As the following graph reflects, the distribution of the City’s fleet by age is skewed by the large number of older vehicles still in the active fleet as of June 2014. In fact, more than 15 percent of the fleet is model year 2000 or older. Also apparent from this figure is the impact of the 2009-10 recession on recent fleet replacement spending levels.

![Figure 5: Distribution of Fleet Assets by Model Year](image)

**Fleet Replacement Planning and Costs**

At present, the City-wide fleet (excluding small tools and equipment) consists of 315 vehicles and pieces of equipment.8 The distribution of assets by types is shown in Figure 8. Fleet Services has developed a long-term fleet replacement plan that identifies projected replacement dates for each asset in the fleet. Each year they meet with their customers to prioritize replacement requests based on operational need and funding availability. Final recommendations, along with a five-year replacement plan, are provided to City Council for final budget approval.

8 Note that small tools and other fleet assets with an individual replacement cost value estimated to be under $5,000 were not included in the fleet replacement analysis.
The City fleet has an estimated total replacement cost (in 2014 dollars) of $35.4 million. Estimated asset purchase prices vary, by asset type, from $5,000 (e.g., small utility trailer) to $1.7 million (aerial ladder fire apparatus).

In order to further evaluate the City’s fleet replacement practices, we quantified the long-term replacement costs of the fleet using our proprietary computer program CARCAP™ (Capital Asset Replacement Cost Analysis Program™). We used this program to develop fleet replacement plans and analyze various costs and other outcomes associated with their implementation. This program allows us to project the remaining life, future replacement dates, replacement costs, residual values, ages, book and fair market values, book and effective depreciation costs, and maintenance and repair costs of each individual asset in a fleet.

CARCAP™ generates a replacement plan by 1) comparing the current age and odometer or hour meter reading of each individual asset in the fleet against recommended replacement criteria in age, kilometers, or engine hours for that type of asset; 2) projecting when each asset will reach each applicable criterion or threshold for replacement; and 3) estimating the purchase price of the asset in the year in which it will reach whichever threshold comes first.

The specific steps we followed to determine the replacement costs of the City of Prince George’s fleet were the following:

1. Obtain a detailed inventory of all fleet assets;
2. Assign every asset in the inventory to a specific vehicle or equipment category or class;
3. Develop analysis parameters (e.g., recommended replacement cycles in months - in addition to the optimal cycles identified for the four asset categories discussed above - current purchase price, and purchase price inflation rate) for each asset class;

4. Apply these parameters to the fleet inventory to develop a “baseline” fleet replacement plan that predicts the future replacement dates and costs of every individual asset in the fleet over the next 20 years; and

5. “Smooth” the baseline plan to obtain a more realistic replacement plan capable of being implemented.

Our analysis made no assumptions about future changes in the size or composition of the fleet.

Using these replacement cycle guidelines, purchase prices, and other planning parameters, we developed the baseline replacement plan shown graphically in Figure 9. This plan projects future replacement dates and costs for each asset in the fleet each time during the 20-year analysis period that it meets the recommended age for replacement. This figure shows the sum of the resulting fleet replacement costs by year.
As can be seen from the exhibit, there is a backlog of assets in need of replacement, where "backlog" is defined as the number and replacement cost of units in the first year of a replacement plan that meet or exceed the recommended age for replacement. In the fleet, 166 assets – roughly 53 percent of the total of all the assets – will meet or exceed recommended replacement cycles in the first year of the plan. The estimated replacement cost of these vehicles (in 2015 dollars) is $13.0 million. Figure 10 below summarizes selected information on the fleet that can be gleaned from the baseline plan.

**Figure 8**

<table>
<thead>
<tr>
<th>Fleet Replacement Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of assets in replacement analysis</td>
</tr>
<tr>
<td>Number of asset classifications</td>
</tr>
<tr>
<td>Current mean asset age (years)</td>
</tr>
<tr>
<td><em>De facto</em> average replacement cycle (years)</td>
</tr>
<tr>
<td>Average recommended replacement cycle (years)</td>
</tr>
<tr>
<td>Average asset purchase price (2014 dollars)</td>
</tr>
<tr>
<td>Gross fleet replacement cost (2014 dollars)</td>
</tr>
<tr>
<td>Average annual fleet replacement spending requirement</td>
</tr>
<tr>
<td>Average annual replacement expenditures (2009-13)</td>
</tr>
<tr>
<td>Current replacement backlog</td>
</tr>
<tr>
<td>Number of assets that exceed recommended replacement age</td>
</tr>
<tr>
<td>Percentage of assets that exceed recommended age</td>
</tr>
</tbody>
</table>

The above table indicates that the City is spending too little on fleet replacement to ensure that its fleet assets are replaced in a timely manner. The estimated replacement cost of all the vehicles in the fleet is $34.5 million. If the vehicles in the program are to be replaced every 9.5 years, the average annual replacement cost of the fleet would be $3.7 million (excluding the proceeds from the sale of used vehicles). Over the last five years, however, the City’s actual capital outlay for vehicle purchases averaged around $1.7 million per year.

As can be seen in Figure 9, the baseline replacement plan has many peaks and valleys in future spending requirements, the largest of which would result from the actual replacement of more than $13.0 million worth of assets in the first year. The existing replacement backlog did not arise overnight and there is no reason to think that it can or should be eliminated overnight. In short, the baseline replacement plan is a very valuable benchmarking tool, but not a practical plan for modernizing the City of Prince George’s fleet. Since there is no compelling reason for the City to eliminate this backlog in a single year, the next step in our analysis was to create a “smoothed” replacement plan by modifying the initial replacement dates of many individual assets in the fleet. The results of this plan smoothing process are illustrated in Figure 11.
While there are still some peaks and valleys in this “smoothed” replacement plan, it is more consistent in the early years of the plan. All subsequent analysis for the purposes of evaluating alternative financing approaches uses the smoothed fleet replacement plan.

**Figure 9
Smoothed Replacement Plan**

Financing Fleet Replacement Costs

Cities such as Prince George generally use one (or a combination) of methods for financing fleet capital costs:

- Purchase with cash using funds appropriated on an ad hoc (year-to-year) basis;
- Purchase with cash accumulated in a sinking or reserve fund, usually accompanied by a cost-charge back system that collects funds from fleet user organizations incrementally to defray the costs of the fleet assets they use;
Purchase with funds borrowed from financial institutions (e.g., an equipment loan, a master “lease-purchase” agreement, a line of credit, etc.) and/or investors (e.g., certificates of participation, general obligation bonds, etc.); and/or

Leasing from a fleet leasing company, the financing arm of a vehicle/equipment manufacturer; and/or another type of financial institution, such as a bank.

There are advantages and disadvantages to each of these approaches, several of which are discussed below.

**Outright Purchase with Ad Hoc Appropriations of Cash**

We refer to the use of annual, ad hoc appropriations of cash to finance the replacement of fleet assets as a “pay-before-you-go” approach. By this, we mean that the entire capital cost of replacing each asset in the fleet is paid at the beginning of the asset’s service life.

The advantages and disadvantages of the cash financing approach can be summarized as follows.

**Advantages**

- This is an approach that is widely used in the public sector; therefore it is generally accepted in all branches of government and by the public. It is the simplest of the capital financing methods to administer.

- There is no out-of-pocket interest expense. This can be a real advantage from a fiscal perspective but not necessarily from an economic one. Specifically, unless an organization has cash in excess of its needs, using cash to pay the full purchase prices of vehicles before they are used is not “free.” The cost of using cash in such a manner involves the opportunity that is lost to use the cash to other organizational priorities that might yield a higher “return” or, at a bare minimum, to earn interest on the cash by investing it.

**Disadvantages**

- The use of this financing approach almost always leads to sub-optimal replacement decision making. This results from the inherent conflict, described earlier, between short-term budget making and vehicle total cost of ownership minimization, which requires a long-term perspective. If the marginal cost of replacing a vehicle is the full purchase price of a new vehicle, repairing an old vehicle will almost always be cheaper in fiscal terms than replacing it.

- If no cost charge-back system or other incremental payment method exists, the ongoing cost of having a vehicle at the disposal of an organization is not apparent to vehicle users, leading to the inefficient deployment and utilization of fleet resources. Fleet users experience little economic benefit in disposing of underutilized or unneeded vehicles whose original purchase price they view as a sunk cost.
It is our experience that the cash financing approach is the least effective method for financing the replacement of fleet assets over the long term.

**Sinking Fund and Charge-Back System**

Although replacement *spending* requirements under a sinking fund approach are identical to those required if cash financing is used, replacement *funding* requirements are different. This is because using a sinking fund permits vehicles’ capital costs to be paid for incrementally (after a vehicle is first added to the fleet; the first-time purchase of a vehicle must be paid up front under this financing approach). That is, each year users are charged for a portion of the vehicle’s replacement cost (i.e. depreciation plus a replacement surcharge) and this is put into “savings” to pay for the replacement vehicle when the time comes.

The advantages and disadvantages of the sinking fund financing approach are summarized as follows.

**Advantages**

- Replacement funding requirements (i.e., fiscal impacts) do not fluctuate significantly from year to year because using a sinking fund permits the capital costs of vehicles to be paid for incrementally. Smooth, predictable funding requirements increase the likelihood that sufficient funds will be made available to replace all vehicles in a timely manner because the annual budget process is never “blindsided” by unexpectedly large appropriation requests.

- Sinking funds are often less of an annual target for decision makers who sometimes equate requests for capital appropriations with discretionary or quasi-discretionary spending needs.

- Payment of regular charges for the use of each vehicle in the fleet encourages fleet user organizations to pay attention to how many and what types of vehicles they need to meet their business needs (in contrast to the cash financing approach where the ongoing costs of having assets at their disposal are largely ignored because they are perceived of as having been one-time expenses that, by definition, occurred in the past).

**Disadvantages**

- This financing method requires rigorous and administratively complex fund management procedures, including the proper development and application of charge-back rates, to ensure that reserve fund inflows and balances are sufficient to meet replacement spending outflows. Failure to do so leads to depleting the fund balance or building up unnecessarily large fund balances.

- The cash in a sinking fund is susceptible to being diverted to meet other spending needs or simply not used, usually out of an overabundance of caution, when budget dollars get tight.
Financing fleet growth to meet new programmatic needs is somewhat expensive because it requires that funds be appropriated to the user agency both for the entire purchase price of the new asset(s) and for the payment of the first year's replacement charges for the asset(s).

Despite these drawbacks, sinking funds are far superior to the cash financing approach in terms of sustaining replacement programs in the public sector and they work well for many government jurisdictions.

**Debt Financing and Leasing**

Like a sinking fund, debt financing allows organizations to spread the capital costs of fleet replacement purchases over the service lives of the vehicles in the fleet. However, rather than accumulating cash in a sinking fund to pay for replacement vehicle purchases, this approach involves borrowing money and repaying it after vehicles have been placed in service.

The primary advantages and disadvantages of the debt financing and leasing approaches are summarized as follows.

**Advantages**

- As with a sinking fund, debt financing and leasing allow organizations to spread out the capital costs of fleet replacement purchases over the service lives of the vehicles in the fleet. This eliminates most of the year-to-year volatility in replacement funding requirements, and reduces the likelihood that fleet replacement spending will be subordinated to other priorities and needs, particularly during lean budget years.
- Allows the cost of money (i.e., interest charges) to be passed on appropriately to all programs.
- If loan or lease payments are made by fleet user agencies directly or via an internal cost charge-back system, greater attention to vehicle selection and utilization will occur. This results in fleet size and composition that is better attuned to actual fleet user agency operating needs and, hence, lower overall fleet costs.

**Disadvantages**

- As indicated above, the use of debt creates competition for the use of statutorily (and often politically) limited borrowing capacity with capital improvement project funding needs that usually enjoy stronger political support than does the routine replacement of vehicles.
- One of the *perceived* drawbacks of debt financing is the cost of borrowing money; i.e., real or imputed interest charges. There is no question that interest charges increase the total capital cost of a vehicle. However, to the extent that debt financing enables an organization to replace vehicles that it otherwise would keep in service for excessive periods of time, interest payments may actually result in lower vehicle total cost of ownership.
It may be difficult to change back to a sinking fund or cash financing approach once an organization has committed to debt or lease financing.

Since about mid-2010, the City has been financing the replacement of vehicles primarily by entering into 5-year capital “leases” (i.e., loans) with the Municipal Finance Authority (MFA). Regardless of a given asset’s useful life, the City secures a 5-year loan and pays off the principal balance at the end of the 5th year. In the case of a unit that has a service life of 12 years, the City makes payments on the first 5 years of the loan on a 12 year loan (roughly 40 percent of the acquisition cost) and then pays the balance at the end of the 5th year. In the case of a unit that has a service life of 8 years, the payment schedule is adjusted to a maximum of 50 percent of the acquisition cost over 5 years. Again, the balance is paid off at the end of the 5 years. Any remaining balance (i.e., the amount not repaid during the initial five year period) is funded by the Mobile Equipment Replacement Reserve (MERR).

The MERR was initially established to work as a traditional sinking fund. Users were charged a rental rate that included a capital and operating component. The capital portion of the rate was calculated to recover the full capital cost of the asset and a surcharge to provide for the additional cost of the asset when it was replaced. These revenues were deposited into the MERR to provide funds for the future replacement of the asset. All disposal proceeds from the sale of decommissioned fleet assets were also deposited into the MERR.

However, since 2010 when the City moved to the MFA financing approach, the capital charge-back rate has not been tied to the actual capital cost of the asset. For example, if a Zamboni is acquired using MFA financing under this approach, and has an expected useful life of 10 years, a monthly loan payment is calculated for 120 months. However, the customer is only charged the actual monthly loan payment for the initial 60 months (the maximum term limit allowed without electoral assent). There is no attempt to recover the remaining 60 months’ worth of payments from the customer. The loan balance is then paid at the end of 60 months with funds that have been previously deposited in the MERR. The current balance in the MERR is $3.7 million. Of that amount, the City is already committed for existing loan buyouts of $2.1 million.

While a debt financing approach for fleet renewal is a viable financing alternative, the fact that the amount charged to the customer does not equate to the actual capital cost of the asset is not appropriate or sustainable with the current funds in the MERR. The payback period should be aligned as closely as possible to the actual expected useful life of the asset. We understand that the current 5 year loan payback period is permitted without additional approval of the electors.

**Replacement Financing Options**

The final step in this component of the project was to explore the merits of several replacement financing approaches that might merit consideration by the City. The approaches selected for investigation were: outright purchase using cash from ad hoc
(year-to-year) appropriations, a sinking fund, and loans. We made this comparison using the smoothed replacement plan shown in Figure 11.

Our fleet replacement planning and cost analysis software CARCAP is designed to calculate funding requirements, by vehicle and by year, under each of these approaches.

**Outright Cash Purchase**

In the case of cash appropriations, the annual funding requirement is equal to the net fleet replacement costs (purchase price less sales proceeds) of replaced assets, as identified in Figure 12. Under this approach the City would be required to meet the total funding requirements each year with cash.

**Figure 10**

*Replacement Funding Requirements under Outright Cash Purchase Financing Approach*

**Replacement Reserve Fund**
In the case of a replacement reserve or sinking fund, 100 percent of the purchase price is paid from the sinking fund in the year the vehicle is replaced and proceeds from the sale of the vehicle are placed in the fund in the year in which it is disposed of. Budgetarily, the annual cost is the sum of replacement rate income from all vehicles.

The replacement rates we calculated for each vehicle in the fleet include two components: 1) a depreciation charge that is based on the original purchase price of the asset less its projected residual value at the end of its useful life; and 2) a replacement surcharge, which is computed based on the long-term difference between reserve fund starting balance, income from depreciation charges, used vehicle sale proceeds, and interest earnings, and outlays for replacement purchases. The surcharge is calculated so that each vehicle is appropriately charged based on its percentage share of the total capital costs of all the assets in the sinking fund-based replacement program.

Figure 13 shows annual fleet replacement costs, funding requirements (i.e., replacement charges), and the sinking fund balance over a 20-year period. The beginning balance for FY 2015 is assumed to be $1.6 million (the current MERR balance less previously committed MERR funds for projected MFA loan “buyouts”). The bars in this exhibit represent gross fleet replacement costs each year; the line shows year-to-year sinking fund revenues, which are the amounts that the City would charge fleet users for their assigned vehicles; the yellow triangles represent additional infusions of cash required to maintain a positive fund balance, and the shaded area represents the fund balance in each year.
Figure 11
Replacement Funding Requirements under Reserve Fund Financing Approach

Note that the fund balance increases in the years leading up to major spikes in replacement spending needs. It is this fund balance that serves to smooth out the peaks and valleys in replacement funding requirements. Because a sinking fund permits the payment of fleet capital costs incrementally, spikes in these costs usually do not result in the deferral of fleet replacement purchases and the development of large replacement backlogs (as long as there is the political will to expend the funds). As can be seen, there is not enough cash in the sinking fund to pay for the implementation of the smoothed replacement plan we developed. Additional infusions of cash, either a large infusion initially or smaller infusions over a period of years, as depicted in Figure 13 would be required to maintain a positive fund balance.

Loan Financing

In the case of a loan financing program, the funding requirement is a monthly or annual loan payment amount based on a user-defined financing period and (all-in) cost of borrowing; a loan pay-off amount, applied in the event that a vehicle must be retired before the end of the assumed financing period; and proceeds from the sale of the vehicle at the end of its life, which are assumed to be received in the year in which it is replaced. We utilized our recommended replacement cycles as the loan term except in
instances where the cycles exceed 120 months where the loan term was set at 120 months and not the current 5 year payback term limits under the current approach. Charge-back rates would be set to recover the full cost of the loan and no “balloon” payments would be required at the end of 5 years. The use of this financing approach would require electoral assent since it is committing the City to payments for a period exceeding five years. Under this approach, there is no need to maintain a capital equipment reserve fund (i.e. MERR). Figure 14 shows the annual replacement costs and funding requirements using a loan financing program.

**Figure 12**
*Replacement Funding Requirements under Loan Financing Approach*

**Comparison of Financing Approaches**

Figure 15 compares several replacement financing approaches. The approaches selected for investigation were: ad hoc appropriations of cash, a sinking fund, and debt financing (loans). CARCAP™ is designed to calculate funding requirements, by vehicle and by year, under each of these approaches.
Another obvious distinction between the cash and reserve fund approaches, on the one hand, and the debt approach on the other, is the sizable near-term budgetary savings that would be realized by moving to a more traditional debt financing approach where the cost of the asset is paid for over the expected useful life of the asset. A side-by-side comparison of the fiscal impacts of the three financing approaches over the next 1, 5, and 10-year periods are is shown in Figure 16.

**Figure 14**  
*Comparative Funding Requirements and Potential Budgetary Savings*

<table>
<thead>
<tr>
<th>Approach</th>
<th>Year 1</th>
<th>Years 1-5</th>
<th>Years 1-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outright Cash</td>
<td>$3.9 M</td>
<td>$20.5 M</td>
<td>$39.9 M</td>
</tr>
<tr>
<td>Reserve Fund</td>
<td>$2.7 M</td>
<td>$19.6 M</td>
<td>$38.5 M</td>
</tr>
<tr>
<td>Loans</td>
<td>$0.1 M</td>
<td>$6.9 M</td>
<td>$25.1 M</td>
</tr>
<tr>
<td>Budgetary Savings Using Loans v. Reserve Fund</td>
<td>$2.6 M</td>
<td>$12.7 M</td>
<td>$13.4 M</td>
</tr>
</tbody>
</table>
As can be seen, the City could realize budgetary savings estimated at $12.7 million over the next five fiscal years by using a debt financing approach where loan terms (and payments) are tied closely to the expected useful life of the assets over a reserve fund approach. Although this would require electoral assent, it would also eliminate the need for the MERR, freeing up an additional $1.6 million in funds.

CONCLUSIONS

The City is not replacing its fleet assets in an effective manner under its current financing approach of using MFA financing where repayment of the loan is capped at 5 years. An indication of how well the City has been served by this financing approach is the current average age of the assets in its fleet, which is roughly double what it should be. Replacements have been significantly curtailed over the last several years, most likely due to concerns that the MERR balance would not be sufficient to fund additional loan payoffs if new approvals were acquired using the current approach.

RECOMMENDATIONS

- Adopt the changes to replacement cycles contained in this report (Figure 6). Ensure these cycles are followed in order to lower the overall age of the fleet.

- Depending upon the capital financing approach used, and not taking into account current MFA loan obligations (which would be covered by a portion of the current MERR fund balance), the average gross replacement cost of the City’s fleet ranges from $2.5 to $4.0 million per year over the next 10 years. These amounts would be reduced by the proceeds from the sale of used vehicles which are estimated to average $0.53 million per year over the same period. Thus, average annual net fleet replacement spending requirements would be approximately $2.0 to $3.5 million per year.

  - To the extent that the City continues with the current approach (MFA), capital charge-back rates should be calculated to recover the full cost of the asset, including the monthly loan payment, fees, taxes, and the outstanding balance at the end of the 5 years.

  - To the extent that a more traditional debt financing approach (i.e., aligning loan terms to the expected useful life of the asset) is selected, users should be charged capital charge-back rates to recover the full cost of the loan and any applicable fees, taxes, and other costs. Elector assent may be required for this approach.

  - To the extent that the decision is made to revive the sinking fund financing approach, establish additional policies and procedures, including formal memoranda of understanding with City budget and finance officials and fleet user agencies, aimed at using this approach in the manner intended – that is, replacing fleet assets in accordance with established guidelines so that de
Draft Report on Fleet Replacement Practices

facto replacement cycles do not continue to be significantly more than the intended cycles.
Appendix

Optimal Replacement Cycle Analysis - Loaders

Optimal Replacement Cycle Analysis - Graders

Optimal Replacement Cycle Analysis – Sidewalk Snow Machine
Figure 15
Optimal Replacement Cycle Analysis for Loaders

<table>
<thead>
<tr>
<th>Replacement Cycle (years)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year-End Odometer Reading (hrs)</td>
<td>1,670</td>
<td>3,340</td>
<td>5,010</td>
<td>6,880</td>
<td>8,350</td>
<td>10,020</td>
<td>11,690</td>
<td>13,360</td>
<td>15,030</td>
<td>16,700</td>
<td>18,370</td>
<td>20,040</td>
<td>21,710</td>
<td>23,380</td>
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<td>Capital Cost</td>
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<tr>
<td>Operating Costs</td>
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<td>$7,572</td>
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<td>$36,460</td>
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<td>$39,466</td>
<td>$41,061</td>
<td>$42,720</td>
<td>$44,446</td>
<td>$46,241</td>
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<tr>
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<td>$201,748</td>
<td>$270,968</td>
<td>$337,036</td>
<td>$400,829</td>
<td>$463,092</td>
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<td>$78,088</td>
<td>$75,906</td>
<td>$74,234</td>
<td>$72,949</td>
<td>$71,971</td>
<td>$71,244</td>
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## Optimal Replacement Cycle Analysis for Graders

**Figure 16**

<table>
<thead>
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<th>Replacement Cycle (years)</th>
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<th>2</th>
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<th>7</th>
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<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
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</thead>
<tbody>
<tr>
<td>Year-End Odometer Reading (hrs)</td>
<td>1,238</td>
<td>2,476</td>
<td>3,714</td>
<td>4,952</td>
<td>6,190</td>
<td>7,428</td>
<td>8,666</td>
<td>9,904</td>
<td>11,142</td>
<td>12,380</td>
<td>13,618</td>
<td>14,856</td>
<td>16,094</td>
<td>17,332</td>
<td>18,570</td>
<td>19,808</td>
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<td><strong>Capital Cost</strong></td>
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<tr>
<td>Depreciation Schedule</td>
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<td>58.5%</td>
<td>48.8%</td>
<td>34.1%</td>
<td>28.5%</td>
<td>23.8%</td>
<td>19.9%</td>
<td>16.6%</td>
<td>13.9%</td>
<td>11.6%</td>
<td>9.7%</td>
<td>8.1%</td>
<td>6.7%</td>
<td>5.6%</td>
<td>4.7%</td>
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<td>Capital Cost ($)</td>
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<td>32,266</td>
<td>26,951</td>
<td>22,511</td>
<td>18,803</td>
<td>15,705</td>
<td>13,118</td>
<td>10,957</td>
<td>9,152</td>
<td>7,645</td>
<td>6,385</td>
<td>5,333</td>
<td>4,455</td>
<td>3,721</td>
<td>3,108</td>
</tr>
<tr>
<td><strong>Operating Costs</strong></td>
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</tr>
<tr>
<td>Annual M&amp;R Cost ($)</td>
<td>4,299</td>
<td>4,562</td>
<td>4,842</td>
<td>5,139</td>
<td>5,455</td>
<td>5,790</td>
<td>6,145</td>
<td>6,522</td>
<td>6,922</td>
<td>7,347</td>
<td>7,798</td>
<td>8,277</td>
<td>8,784</td>
<td>9,324</td>
<td>9,896</td>
<td>10,503</td>
</tr>
<tr>
<td>Annual Fuel Cost ($)</td>
<td>30,620</td>
<td>31,857</td>
<td>33,144</td>
<td>34,483</td>
<td>35,876</td>
<td>37,326</td>
<td>38,834</td>
<td>40,403</td>
<td>42,035</td>
<td>43,734</td>
<td>45,501</td>
<td>47,339</td>
<td>49,252</td>
<td>51,242</td>
<td>48,522</td>
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<tr>
<td>Total Annual Operating Cost ($)</td>
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<td>37,986</td>
<td>39,622</td>
<td>41,331</td>
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<td>44,979</td>
<td>46,925</td>
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<tr>
<td><strong>Total Cost</strong></td>
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<tr>
<td>Annual Total Cost ($)</td>
<td>135,418</td>
<td>75,048</td>
<td>70,252</td>
<td>66,573</td>
<td>63,842</td>
<td>61,918</td>
<td>60,684</td>
<td>60,043</td>
<td>59,915</td>
<td>60,233</td>
<td>60,943</td>
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<td>63,370</td>
<td>65,020</td>
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<td>411,134</td>
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<td>653,694</td>
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<td>94,217</td>
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<td>83,133</td>
<td>79,853</td>
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Figure 17
Optimal Replacement Cycle Analysis for Sidewalk Snow Machines

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<th>Replacement Cycle (years)</th>
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<th>13</th>
<th>14</th>
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<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year-End Odometer Reading (hrs)</td>
<td>476</td>
<td>952</td>
<td>1,428</td>
<td>1,904</td>
<td>2,380</td>
<td>2,856</td>
<td>3,332</td>
<td>3,808</td>
<td>4,284</td>
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<td>5,236</td>
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<td>6,644</td>
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<td></td>
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</tr>
<tr>
<td>Annual M&amp;R Cost</td>
<td>$4,299</td>
<td>$4,562</td>
<td>$4,842</td>
<td>$5,139</td>
<td>$5,455</td>
<td>$5,790</td>
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<td>$9,324</td>
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<td>$8,278</td>
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<td>$8,731</td>
<td>$8,970</td>
<td>$9,218</td>
<td>$9,475</td>
<td>$9,742</td>
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<td>$10,605</td>
<td>$10,915</td>
<td>$11,237</td>
<td>$11,524</td>
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