SUSTAINABLE ASSET MANAGEMENT

THE THOMPSON ECONOMIC DIVERSIFICATION WORKING GROUP
FINAL REPORT  July 2012

Regulatory Framework : Sustainable Asset Management
THOMPSON ECONOMIC DIVERSIFICATION WORKING GROUP

Working Group Members

- THOMPSON UNLIMITED
- CITY (CHAIR)
- PROVINCE of MANITOBA
- FEDERAL GOVERNMENT
- VALE
- UNITED STEEL WORKERS LOCAL 6166
- rePLAN
- MMF
- NACC
- NCN
- KTC
- MKO

Invited Stakeholders

- THOMPSON CHAMBER OF COMMERCE
- KTC
- rePLAN
- NACC
- MMF
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>1.1</td>
<td>The Thompson Economic Diversification Working Group</td>
<td>1</td>
</tr>
<tr>
<td>1.2</td>
<td>Background and Purpose of this Plan</td>
<td>1</td>
</tr>
<tr>
<td>2.0</td>
<td>Asset Management Framework</td>
<td>2</td>
</tr>
<tr>
<td>2.1</td>
<td>Asset Knowledge</td>
<td>2</td>
</tr>
<tr>
<td>2.2</td>
<td>Asset Cycle</td>
<td>2</td>
</tr>
<tr>
<td>2.3</td>
<td>Financial Situation</td>
<td>3</td>
</tr>
<tr>
<td>2.4</td>
<td>Decision Making</td>
<td>3</td>
</tr>
<tr>
<td>2.5</td>
<td>Governance</td>
<td>3</td>
</tr>
<tr>
<td>2.6</td>
<td>Sustainability Monitoring</td>
<td>3</td>
</tr>
<tr>
<td>3.0</td>
<td>Application of Framework</td>
<td>5</td>
</tr>
<tr>
<td>3.1</td>
<td>Background</td>
<td>5</td>
</tr>
<tr>
<td>3.2</td>
<td>Asset Knowledge</td>
<td>5</td>
</tr>
<tr>
<td>3.2.1</td>
<td>Existing Data</td>
<td>5</td>
</tr>
<tr>
<td>3.2.2</td>
<td>Segmentation</td>
<td>5</td>
</tr>
<tr>
<td>3.3</td>
<td>Asset Lifecycle</td>
<td>6</td>
</tr>
<tr>
<td>3.3.1</td>
<td>Level of Service</td>
<td>6</td>
</tr>
<tr>
<td>3.3.2</td>
<td>Condition Deterioration</td>
<td>6</td>
</tr>
<tr>
<td>3.3.3</td>
<td>Break Density</td>
<td>6</td>
</tr>
<tr>
<td>3.3.4</td>
<td>Condition Stages</td>
<td>7</td>
</tr>
<tr>
<td>3.3.5</td>
<td>Treatment Strategies</td>
<td>8</td>
</tr>
<tr>
<td>3.3.6</td>
<td>Lifecycle Costing</td>
<td>9</td>
</tr>
<tr>
<td>3.4</td>
<td>Financial Situation</td>
<td>10</td>
</tr>
<tr>
<td>3.4.1</td>
<td>Financial Parameters</td>
<td>10</td>
</tr>
<tr>
<td>3.4.2</td>
<td>Treatment Expenditures</td>
<td>10</td>
</tr>
<tr>
<td>3.4.3</td>
<td>Revenue</td>
<td>10</td>
</tr>
<tr>
<td>3.5</td>
<td>Decision Making</td>
<td>10</td>
</tr>
<tr>
<td>3.5.1</td>
<td>Defining Level of Service</td>
<td>10</td>
</tr>
<tr>
<td>3.5.2</td>
<td>Treatment Strategy Implementation</td>
<td>10</td>
</tr>
<tr>
<td>3.5.3</td>
<td>Segmentation Classification</td>
<td>10</td>
</tr>
<tr>
<td>3.6</td>
<td>Governance</td>
<td>11</td>
</tr>
<tr>
<td>3.7</td>
<td>Sustainability Monitoring</td>
<td>11</td>
</tr>
<tr>
<td>4.0</td>
<td>Conclusions</td>
<td>12</td>
</tr>
<tr>
<td>5.0</td>
<td>Recommendations</td>
<td>13</td>
</tr>
</tbody>
</table>
1. **INTRODUCTION**

1.1 The Thompson Economic Diversification Working Group

The need to broaden and diversify the economic base in Thompson and surrounding region is a long-standing priority. Economic volatility in recent years, coupled with the November 2010 announcement that Vale will transition its operations in Thompson to mining and milling by 2015, have underlined the need for the City, the region and community partners to tackle this issue head on.

The Thompson Economic Diversification Working Group (TEDWG) was formed to spearhead this effort. Launched on May 18, 2011, the TEDWG has a simple mission: to accelerate Thompson’s development as a regional service centre in Northern Manitoba with a strong mining pillar. The TEDWG is chaired by the City of Thompson, and enjoys broad and diverse stakeholder participation with representatives from the Province of Manitoba, Vale, Manitoba Keewatinowi Okimakanak (MKO), Keewatin Tribal Council (KTC), Manitoba Metis Federation (MMF), the Northern Association of Community Councils (NACC), Nisichawayasihk Cree Nation (NCN), Thompson Unlimited, and the Thompson Chamber of Commerce. The Government of Canada and USW Local 6166 have also been invited to participate. TEDWG is being support by rePlan, a Canadian planning organization that works with resource-based communities in Canada and internationally.

This group is responsible for identifying and pursuing the most promising opportunities to help Thompson and the surrounding region diversify its economy and strengthen its position as an economic contributor in Northern Manitoba. Priority areas identified by TEDWG stakeholders include:

- Restorative Justice
- Education and Training
- Housing
- Fostering a Local and Regional Identity
- Economic Development

Sub-committees, including representatives of the above mentioned organizations as well as other regional stakeholders, have been established to address these priority areas and prepare plans that support immediate action.

In addition, the TEDWG stakeholders are committed to strengthening the City of Thompson’s governance framework through an updated District Development Plan and Zoning By-Law. The dynamic relationship between the City of Thompson and regional communities will be better defined through another initiative of the TEDWG, the Thompson and Region Infrastructure Plan. When taken together, the District Development Plan, Zoning By-Law and Thompson and Region Infrastructure Plan provide a 20-year strategy to stimulate and manage both economic and population growth through targeted infrastructure development and sustainable land use planning in Thompson and region.

The TEDWG process will provide immediate direction on the specific priorities outlined above. It will also provide a framework for continued collaboration between regional stakeholders and continued action to support economic diversification and development over the long-term.

1.2 Background and Purpose of this Plan

A Sustainable Asset Management Framework that can be applied to various community assets was a key recommendation of the Sustainable Community Plan for the City of Thompson and Planning District.

In Fall 2011, Thompson Economic Diversification Working Group members initiated the asset management planning process. In December 2011, Associated Engineering (AE) was retained to guide the City of Thompson in the development and implementation of an Asset Management framework and to apply the framework to the City’s water distribution network. The development and implementation of an Asset Management plan can be an extensive and exhaustive process, sometimes taking years to be fully implemented and benefits realized. The intent of this project is to provide a roadmap of how to initiate a sustainable asset management business process and plan. The implementation of each component of the framework will ultimately become a process of continuous improvement for the City.

In addition, this framework should be used as a general guideline for Asset Management that can be applied to other asset classes.

The AE project team would like to acknowledge the considerable assistance they received in the development of this project from the City of Thompson, namely: Craig Finlay, Manager of Assets and Infrastructure; Mike Webb, Engineering Tech; and Chris Ettinger, Engineering Tech.
2. ASSET MANAGEMENT FRAMEWORK

Associated Engineering identified six components that need to be addressed in the establishment of an asset management framework, based on Industry Best Practices. The six components of the framework include:

2.1 Asset Knowledge

Asset knowledge is the intelligent compilation of asset information within an asset inventory or register with detailed attributes for existing assets. Different assets will require different levels of information, but the structure of the information should be comparative to allow for subsequent analysis. Basic asset information should include the asset type, quantity/size, material type, installation date, and location.

Information on vertical assets (i.e. vehicle fleets, facilities, major facility equipment) is relatively easy to collect. The assets are usually accessible and have a clear function. For example; all facilities will likely have a foundation, structural supports, and a roof. Most facilities would also have electrical systems, mechanical systems, process piping and plumbing.

Information on linear assets (i.e. water, sanitary sewer, storm sewer, roads) is more difficult to obtain. This information is not always apparent and generally relies on as-built drawings and maintenance records. From a management perspective, the linear assets also need to be divided or compiled into defined segments. This makes comparison easier, more applicable to meet Public Sector Accounting Board (PSAB) reporting requirements and can be easily integrated into a standard reporting tool to customers.

Appurtenances, components and sub-components for/of each asset also have to be inventoried. They are generally identified as "elements" of the overall asset that have substantially different asset life cycles or can be replaced and/or maintained independently. For a water system, this would include valves and hydrants etc., whereas for a fleet, it may mean specialized equipment like a snow plow blade for a truck, or grass cutting attachment for a tractor. When collecting asset information for components and sub-components, the community should set a value threshold to avoid too much detail. For example, some communities will not collect information of assets less than $5,000.

Knowing asset information is important, but maintaining it in a database format is critical. Access to the data is required for multiple purposes and usually by various people within an organization. The data needs to be structured properly for the short and long term, as well as serve the varying needs of the users throughout the organization. This may be as simple as a spreadsheet or as complex as a detailed Geographic Information System (GIS) application. As the asset databases grow in quantity and quality, more robust systems need to be adopted to preserve the integrity of the information and to maintain its comparative value.

2.2 Asset Cycle

An asset lifecycle describes the performance of an asset over time. The analysis of asset lifecycles enables a detailed understanding of how to maintain or improve an asset’s performance.

The first task is to evaluate the current condition of each asset or segment within the asset network. In order to measure condition, an appropriate rating system is adopted. The most important aspect in choosing a rating methodology is to ensure that the method delivers a measurable output and that the process is repeatable. Additional considerations include the frequency of conducting condition evaluations and its subsequent costs as well as how to incorporate maintenance and or failure records into assessing asset condition.

The City should also determine who will be responsible for assessing the asset or asset network as well as tracking the condition data. Identifying the deterioration rate is beneficial in predicting future programs for the asset or asset network. A condition matrix should be developed as well so that segments can be grouped into similar condition states for analysis.

The asset lifecycle should include the development and documentation of Levels of Service (LOS) statements. LOS statements are the outputs that a customer experiences from the delivery of an asset or asset system function. An LOS statement should describe what the organization is intending to achieve and the service attributes that can be measured. It should be written in simple, easy-to-understand terms. An example of a LOS statement is included below:

<table>
<thead>
<tr>
<th>Level of Service:</th>
<th>Provide a safe, reliable, potable water service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer performance measure:</td>
<td>&lt; 3 service interruptions/property/year</td>
</tr>
<tr>
<td>Customer performance target:</td>
<td>&gt; 99% of properties</td>
</tr>
<tr>
<td>Technical performance measure:</td>
<td>&lt; 1.0 break/100 metres of pipe/year and &lt; 2.0 breaks/100 metres of pipe/5 years</td>
</tr>
<tr>
<td>Technical performance target:</td>
<td>&lt; 1.0 per year and &lt; 2.0 per 5 years</td>
</tr>
</tbody>
</table>

The LOS needs to be measurable and repeatable allowing for the measurement of beneficial impact versus capital.
and maintenance investment. This creates an accountability measure within the City and allows targets to be set for asset performance. Understanding the gap between the existing LOS and the desired LOS produces a backlog of rehabilitation projects. This will provide insight to the level of funding required for future programs. Understanding the rate in which assets transition from one condition state to another will identify the minimum cost required to maintain the asset or asset network in its current condition.

All assets require treatment strategies (repair, renew or replace) to maintain or improve their performance. As the City identifies the various condition states for their assets or asset networks, it can apply lifecycle costing analysis to available treatment strategies for each condition state to identify when a treatment is most beneficial and when it will deliver the best return on investment. This approach also allows future technologies to be assessed and applied to asset condition states.

### 2.3 Financial Situation

There are several financial considerations that are important in developing an asset management framework. Two critical considerations are the current replacement value of the asset and the asset’s depreciated value. Current replacement value is what it would cost to replace the asset in today’s dollars and the current depreciated value, also in today’s dollars, of the asset based on its age or condition. When the value of the asset is understood, better decisions can be made regarding its operation and maintenance (O&M) as well as replacement or renewal.

Understanding the current replacement value and the current O&M costs allows the municipality to conduct “whole lifecycle” analysis. Accurate data will enable better decision making around deferral or rehabilitation strategies.

When the City begins to perform lifecycle analysis, it will be important to determine an appropriate rate of return over the short and long term. This decision should have input from financial personnel within the City. This will allow the development of future financial requirements and multi-year plans for renewal.

Lastly, understanding what funding sources are available to the City for specific assets is imperative. Once the City compares its revenue stream to required funding, it will become apparent whether the City is financially sustainable.

### 2.4 Decision Making

The City will need to periodically evaluate their decision making processes for its assets and the LOS those assets provide. This includes identifying who is responsible for making the LOS decisions, what information is being used to make the decision, and whether or not there is any documented evidence to make the decision.

There are several reasons for regularly evaluating and documenting decision-making processes:

1. Once a decision-making process is documented, it is easier to objectively see where improvements in the process can be implemented.
2. Documented procedures help to maintain consistency of a decision-making process over time which allows for the comparison of results, ability to track changes and make the process more robust and defendable.
3. As personnel inevitably change, documented processes enable continuity.

The initial evaluation starts with reviewing and documenting the current process. The City then needs to identify and document the desired decision-making process and, finally, document the gap between the current and the desired process.

### 2.5 Governance

Asset Management plans need to integrate the goals and objectives of citizens, City Council, and City employees as well as satisfy the legislative regulations of operating an asset.

Decisions made that impact an asset should align with the City’s strategic goals. If a department or group operates in isolation, they may not be completing work and/or maintaining the LOS that is necessary to achieve those goals, or they may not be effectively expending funds if they are completing work that is not required to achieve the strategic goals of the City.

Some assets will also have legislative requirements for the operation of the asset. These requirements must also be incorporated into the asset management plan.

### 2.6 Sustainability Monitoring

Monitoring needs to be conducted at several levels. It starts with the asset itself by tracking all activities and associated costs that are performed on the asset. Monitoring at this level provides higher quality data for further evaluation of the asset lifecycle, which in turn provides better future decisions.

Tracking and monitoring costs will provide additional data for evaluating the effectiveness of the activity performed and the efficiency of the crews performing the activities. As the costs of treatment strategies are better understood, the lifecycle costing becomes more accurate and determines whether a treatment strategy is intervening at the proper time in an asset’s lifecycle or if the intervention point needs to be adjusted. Understanding the success of the treatment strategies will also allow the City to track its progress in achieving its goals and objectives.
Although the City may have sustainability goals and objectives, it does not mean the City will be sustainable. Activities or tasks completed need to be evaluated against the strategic plan and overall Sustainable Asset Management Plan. An annual review of these plans will identify if:

- Sustainability goals are being met.
- Outcomes are supporting sustainability.
- Business goals are promoting sustainability.
- Sustainability goals are still appropriate and provide the correct drivers; or
- Sustainability goals should be adjusted.

Monitoring the asset network from this perspective is an integral component of enacting the Sustainable Asset Management Plan and realizing the desired benefits. Each successive review will allow the plan to be improved and allow for the introduction of new strategies. In fact, augmentations and revisions to the plan should be expected. The focus here is to determine if the asset lifecycles are maintaining the initially identified deterioration rate. If there is an acceleration or deceleration to the deterioration rate, a related increase or decrease to the funding required to realize the sustainability goals that have been set may be required.
3. APPLICATION OF FRAMEWORK

3.1 Background
The City of Thompson agreed to the proposed framework and its application towards the City’s water distribution network. With guidance from Associated Engineering, the City began to make progress on the components within the framework and the development of a Sustainable Asset Management Plan for the water distribution network. There was a varying degree of work required for each of the framework components. Some components required full development whereas other components already exist but may require further analysis and integration with the other components. Not all of the components of the framework are complete due to time and resource limitations. However, the following sections will outline what has been done as well as what needs to be done.

3.2 Asset Knowledge

3.2.1 Existing Data
The City of Thompson has very good water distribution system data, both in quality and quantity. The entire water distribution system has been digitally recorded in AutoCAD format. There is a high degree of confidence in the accuracy of the information and there is no need to improve upon the quality of data at this time.

The City provided extensive pipe break data. Separate layers within the AutoCAD environment identified the type and location of pipe breaks over a period of 20 years. This break data is very important and has played a critical role in identifying the lifecycle of the watermains in the City. The break data has also contributed to determining the condition of the City’s watermains.

3.2.2 Segmentation
Segmenting the water distribution system was the first task performed by the City. The City’s water network was constructed with pipes having a variance in material type, diameter and most notably length. The intention of segmenting the pipe network was to establish manageable sized segments that represent a street block. Guidelines for a minimum and maximum length have been introduced, as well as methods to deal with intersecting pipes, appurtenances and segment identification. The segmenting process yielded approximately 325 segments of which 127 segments are identified as cast iron, 136 segments ductile iron, 27 segments PVC and/or HDPE and 35 segments are identified as some combination of pipe material. The 35 segments that have more than one material are grouped together with the singular materials based on which material was predominant. The average length of a pipe segment is 230 metres.

The City’s current water distribution information, as well as other infrastructure data sets, is currently maintained in an AutoCAD format. While AutoCAD offers some Geographic Information System (GIS) functionality, consideration should be given to adopting a dedicated GIS and asset database application. A dedicated GIS has greater capabilities for combining and integrating various information sources (work tracking, inventory alterations, finances, etc.) and maintaining asset history from an auditing point of view in a singular centralized database. This database in turn provides the ability to query and request information as required.
3.3 Asset Lifecycle

3.3.1 Level of Service

Defining levels of service for an asset can be a very difficult task. Users of the asset will have a wide variance of expectations. The higher the LOS required, the higher the cost for that service. For municipalities, it is important to identify the current LOS and the subsequent cost to provide that LOS. Once this is clearly understood, the existing data from the condition matrix can be used to communicate the cost involved in an adjustment of the LOS mandated by Council. The City has not defined their current LOS for the water distribution system. As the system continues to age and deteriorate, the LOS it provides to the community will also continue to decrease if appropriate treatment solutions (Repair versus Renewal) are not adopted. At the very minimum, if the current LOS is to be maintained, then it is anticipated that an increased yearly investment will be required to maintain the condition of the water distribution system.

3.3.2 Condition Deterioration

As assets age, the condition of the asset deteriorates. This is a simple concept; however, measuring that deterioration can be extremely difficult. In the case of the watermain distribution system, soil conditions, water table level, internal watermain pressure, frost depth and pipe material are just some of the factors that can accelerate and/or reduce the rate of deterioration.

With metallic watermains such as cast iron or ductile iron, corrosion is the main cause of failure, so determining the reason for failure, and more importantly, how to measure that failure rate is the first task in determining life cycle of the asset. Condition assessment methods are available that will measure the remaining wall thickness in situ, but these methods are expensive and only provide a “snapshot”. In order to evaluate the rate of deterioration with metallic pipes, these inspection methods would need to be performed on a regular and ongoing basis.

For the purpose of this project, a more economical method was chosen. As previously noted, the watermain break history for the City is well documented. Following the segmenting process, each break that had been documented was attached to the segment, which subsequently provided a break history for each segment. Each break represents the weakest point within a pipe segment (or the fastest corroding portion of the pipe), therefore, a general deterioration rate can be established based on past break history. Breaks are great indicators of pipe deterioration as customers understand their impact. In addition, they are easy to measure.

3.3.3 Break Density

Since asset management considers the network as a whole, a comparison of assets needs to be performed continuously. Break counts are simple to track but since segments vary in length a simple break count may be misleading. To address this potential misrepresentation, break density per metre is employed. To determine break density, the break count was divided by the length of the pipe segment and then multiplied by a standard measure (100 metres). Following the application of this simple formula, each segment could be easily evaluated and compared.

Figure 3.3 above shows the lengths of the segments and the break density ranges that the segments are currently in.
3.3.4 Condition Stages

By understanding the condition deterioration rate and break density for all pipe segments, the next step is to determine the different stages of the asset's lifecycle. For the watermain network, the break density is used to develop a condition matrix. Limitation for break densities are identified and as successive breaks occur, the pipe segment’s overall break density increases, and the condition of the segments increased in severity. The condition matrix developed for the City of Thompson consists of four stages.

1. The first stage is considered ‘Good’; where the break density equals 0 and the segment has not experienced a break. At this stage nothing needs to be done because the segment is not costing the City anything with regard to additional maintenance.

2. The second stage is considered ‘Slight’; where the break density is greater than 0 but less than or equal to 1.0. The majority of the segments have experienced one or two breaks and are just starting to deteriorate. Renewal or rehabilitation strategies are not economically feasible in this stage but deferral strategies may be a consideration.

3. The third stage is considered ‘Moderate’; where the break density is greater than 1.0 but less than or equal to 2.25. The segments in this stage are starting to break rather consistently and from an economic standpoint renewal and/or rehabilitation strategies start becoming economically feasible.

4. The fourth and final stage is considered ‘Extreme’; where the break density is greater than 2.25. Segments in this stage are breaking frequently and renewal and/or rehabilitation strategies are an economic choice rather than continuing to repair.

Originally, the upper limit for the moderate stage was set at a break density of 3.00. Further investigation of the lifecycles indicated that the break density should be lowered to 2.25. Break density was lowered because the data shows that there is less variance in the time between breaks after the fifth break occurs. The intention was to identify the point where this occurs. Using the average segment length (230 metres) on the fifth break yields a break density of 2.17. It was discussed with the City and rounded up to a break density of 2.25 to capture this change in time between break variance.

Figures 3.4 above and 3.5 on the following page show the deterioration in Thompson between 2002 and 2012. The quantity of segments that have moved from “Good” and “Slight” to “Moderate” and “Extreme” is quite noticeable and further, a high percentage of segments are nearing the end of their useful life.

As breaks continue to occur, and provided that the data for each break is properly captured and maintained, the condition matrix for the City’s water distribution network can be kept current with minimum effort.
3.3.5 Treatment Strategies

The next step within the asset lifecycle process is to identify what treatment strategies are available to improve a segment’s condition. At this point it needs to be recognized that different assets will have different treatment strategies and each treatment strategy will have advantages and disadvantages.

Watermains have very few treatment strategies available and City personnel identified they have minimal experience with them. Not having this experience creates a void in estimating costs for potential treatment solutions available to the City of Thompson. As a result, educated assumptions have been made for the costs of two relatively common treatment solutions including open cut replacement and Cured-In-Place Pipe (CIPP).

<table>
<thead>
<tr>
<th>Treatment Strategy</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Approx. Cost per metre</th>
<th>Approximate Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Cut Replacement</td>
<td>• New pipeline</td>
<td>• Very disruptive</td>
<td>$1,500</td>
<td>30 m/day</td>
</tr>
<tr>
<td></td>
<td>• Road renewal</td>
<td>• Expensive</td>
<td></td>
<td>150 m/week</td>
</tr>
<tr>
<td></td>
<td>• Other issues can be addressed (capacity, location)</td>
<td></td>
<td></td>
<td>600 m/month</td>
</tr>
<tr>
<td>Cured-In-Place Pipe (CIPP)</td>
<td>• Minimal disruption</td>
<td>• Does not address capacity issues</td>
<td>$1,000</td>
<td>600 m/week</td>
</tr>
<tr>
<td></td>
<td>• Cost effective</td>
<td>• Not suitable for every situation</td>
<td></td>
<td>2,400 m/month</td>
</tr>
<tr>
<td></td>
<td>• High production rates</td>
<td>• Limited availability of installers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3.6 - Treatment Strategies
3.3.6 Lifecycle Costing

Life cycle costing has been undertaken based on the treatment strategies identified above and the corresponding condition states to determine the most economic timeline for the implementation of each treatment strategy.

Figure 3.7 above identifies the life cycle of a “Good” Ductile Iron watermain segment that experiences its first break in 2012. Using the average time between break data, this segment will experience 10 breaks by 2037. As the break density increases, the condition of the segment progresses through the different condition states. Assuming that replacement occurs in 2038 and estimating a current replacement cost of $345,000 the Net Present Worth at 4% interest would be $183,107 for all repairs and replacement of the segment.

Deferral strategies, such as cathodic protection, were discussed with the City but since costs and the success of cathodic protection in Thompson are unknown, it was not pursued further. However, deferral treatments are generally applied to assets in the early stages of their life cycle with the intention of extending that life cycle. With metallic watermains, cathodic protection is a viable treatment option used by many other municipalities to slow down the corrosion rate and therefore extend the life of the watermain. AE recommends that the City make assumptions for both the cost and the expected life extension that the cathodic protection treatment may provide. However, allocating resources to monitor the success of the treatment for future evaluation would be required. This same process of analysis, implementation and monitoring would be required for any new technology targeted at renewal or deferral strategies.
3.4 Financial Situation

3.4.1 Financial Parameters

Identifying the rate of return of the infrastructure over a defined time frame is an important consideration when performing life cycle costing. These basic financial parameters are required for evaluation purposes. Time frames are equally important when considering the life cycles of different assets. A water distribution system has a long life cycle so using 10 years for short term and 30 years for long term evaluations is suggested. When considering other assets like vehicle fleets, considerably shorter time frames should be utilized. The documentation of these assumptions is critical, as it enables better decision making.

3.4.2 Treatment Expenditures

In order to perform life cycle costing, understanding the financial impact of treatment strategies as well as costs for operational and maintenance procedures is paramount. The current financial tracking process used by the City captures total yearly costs for all operations and maintenance activities, but does not differentiate between the various individual operations and maintenance tasks nor does it assign accurate costs to the newly segmented water system. With the new segments being developed for the water system, an effort should be made to assign the appropriate costs to each individual segment so that evaluation of each segment is more accurate.

The City also has very little experience in implementing treatment strategies; therefore, costs for various strategies are unknown. Going forward, assumptions need to be made with respect to the costs of the available treatments. These assumptions have been used for the initial life cycle costing analysis as presented in the previous section. As experience and knowledge of treatment strategies develops, the actual costs should be captured and reapplied to the condition states using life cycle costing methodology. This task should be performed each year as more experience with renewal and/or rehabilitation strategies is developed.

3.4.3 Revenue

Lastly, having a clear understanding of available revenue streams for each asset is important. A good Asset Management plan will be able to identify financial shortcomings as well as over investment. If revenue streams are properly understood, they can be adjusted accordingly.

3.5 Decision Making

The development of an Asset Management plan requires several key decisions to be made. Documenting these decisions is important, but knowing what input or data is needed to make those decisions and who will be making the decisions is paramount.

3.5.1 Defining Level of Service

For the water distribution system, the most important decision to be made is what LOS is expected from the water distribution system. This decision should be made by Council with input from the City’s Assets and Infrastructure Group and the public. From the existing data, we were able to identify the lowest cost option to maintain the current LOS; however, the importance of safe potable water can vary amongst communities. The scope of this project did not include community engagement to determine the expectations of the general public. Should Council desire to engage the community and solicit public input, a tolerability study would need to be conducted. It may be beneficial to wait a few years before public engagement is sought so the City can gather better information regarding renewal strategies and costs.

3.5.2 Treatment Strategy Implementation

Another important decision to be made is when replacement and/or renewal strategies should be implemented. These decisions should be made by the City’s Asset Management team, based on the condition matrix and life cycle costing analysis. With a condition matrix developed and assuming that the values of replacement and renewal are reasonable, based on current construction costs, good economic decisions for those segments that reach the “Extreme” condition state can be justified. CIPP is a better economic choice than replacement and could be applied to the “Moderate” or “Extreme” condition state segments. However, other considerations such as capacity of the existing line and availability of CIPP contractors may limit the feasibility of this renewal strategy. As experience and knowledge grow with the various treatment strategies and as costs are better developed, the life cycle costing may change, which in turn will provide different information for when and how to treat watermain segments.

3.5.3 Segmentation Classification

The condition matrix that was developed for the water network and the life cycle costing that was performed considered all watermain segments as equal. In reality, certain watermain segments should be identified as having a higher “class” than others. This type of decision should be made by Council and/or Senior Management based on a defined criteria. Segments that are identified as having a higher criticality, in terms of reliability/public safety, need to have a higher level of service for maintenance or rehabilitation. For example, if a pipe segment’s failure has a significant impact on public health (i.e. hospitals), education (i.e. public schools) or a major business (i.e. processing plant), these segments may need a higher class designation. Identifying these various classes should be based on strict guidelines that affect the community as a whole, not one select group’s interest.

The City’s Asset Management team should provide the majority of the information required to make these deci-
sions. If community involvement is an avenue that the City wishes to pursue, the Asset Management team would need to supply the information to educate the public so that they can make informed decisions.

3.6 Governance

This Asset Management framework component primarily involves an internal review of an organization’s strategic goals and any legislation, regulations or policies that may influence the Asset Management plan. This component is more of an exercise to heighten awareness and commitment from the City’s Asset Management team.

For the water distribution system some examples of governance considerations within the Asset Management plan include:

- **Organizational goals**: The City may desire a “green” community and water conservation would be one area to address. An Asset Management plan would need to be in line with any water conservation strategies.

- **Community Growth**: If growth is planned, consideration needs to be given to how that growth will be serviced. Determining whether there is sufficient capacity, pressure and quality need to be analyzed.

- **Annual hydrant flushing**: It is legislated that municipalities flush their hydrants two times per year. The time and cost involved with this task would need to be included in the operational requirements every year.

- **Water Testing**: Potable water systems must be tested on a regular basis and need to meet certain testing levels. This also needs to be incorporated into the operational requirements on a yearly basis.

3.7 Sustainability Monitoring

The City has done a very good job of establishing an inventory and collecting pipe break data over the past 20 years. This project provides direction into how this data can be further utilized and shows that Asset Management is a continuous improvement process that can only improve if all aspects are understood and given proper attention. Important monitoring considerations going forward include:

- Break data should continue to be captured as well as all other operation, maintenance or treatment activities that are performed on each segment.

- Financial data should be capable of determining how much is spent on each segment per year.

- Condition data should remain updated to understand deterioration rates.

- Treatment strategies should be explored and better understood so better decisions can be made. As these treatment costs are better understood, their life cycle costing becomes more accurate.

- Deferral strategies should be introduced as life cycle costing becomes more accurate and the City becomes more efficient in choosing renewal or rehabilitation locations.

More importantly, the City must monitor and assess how they are performing to ensure that sustainability of the assets and their ability to deliver a service remains the objective and complies with the direction given by Council. On a yearly basis, the Asset Management group should be able to:

- Ensure that the proper processes are in place to track watermain break data and that inventory data is updated in a timely fashion.

- Ensure the financial system is capturing the operational and maintenance costs to each segment.

- Identify that the capital investment remains sufficient to address the current deterioration rate of the asset.

- Perform lifecycle costing analysis as treatment costs are identified and ensure that the treatment strategies are being applied to the proper condition state.

- Define and measure accountability in the process.
Asset classes vary significantly in function; therefore the framework that has been developed for sustainable Asset Management in the City of Thompson is a general guideline that can be applied to other asset classes. In brief, this guideline includes:

- Identifying an asset and its important sub-components,
- Determining its condition and cost of operation,
- Determining what options are available to maintain, repair, upgrade or replace that asset, and
- Developing a plan based on the requirements of the community.

The differences between assets require that this framework be general in nature so that it can be flexible and customized to the asset. Some assets will be easier to identify while others will be easier to assess, but each asset will have its own set of challenges in developing asset management plans.

This project focused on applying the framework to the water distribution system to develop an Asset Management plan. As work progressed through the six different components of the framework, some components required extensive analysis. However, due to limited resources and time, some components could not be fully analyzed and were simply discussed at a summary level.

This project focused on organizing the asset data, developing a condition matrix, and some basic life cycle costing. Developing levels of service standards, understanding the financial connection to assets and developing monitoring protocols were discussed and need to be further addressed by the City Asset Management team and City Council.

Asset Management plans take time to implement and tangible benefits (i.e. cost savings, improved service) may not be realized for a few years. Intangible benefits may be realized immediately, such as improved data organization and an increased understanding of network performance. As the City gains more knowledge and experience with rehabilitation strategies and are able to monitor their operating costs more efficiently, they will be able to perform more accurate life cycle costing. This in turn will provide more information to present to the community for developing level of service standards. In order to be sustainable, the City needs the most economical strategy to achieve their desired levels of service.
5. RECOMMENDATIONS

As previously mentioned, certain components of the framework were not completed during this project. Several projects that could further advance the Asset Management framework include:

1. Integrate a Geographic Information System (GIS): The City currently maintains its entire asset inventory and break data related to the water distribution network on AutoCAD. The segmentation and condition matrix that was developed during this project is based in MS Excel format. In order to maintain the data going forward, there will be a considerable amount of effort required since the different data sets are not linked. If the City integrates a GIS setup, it can link all these data sets and update them simultaneously with considerably less effort. It is also possible to link financial data through a work order system and capture those costs to each segment. This GIS system should also be able to link to other asset classes such as sewer, storm, roads and facilities, which will be important for the analysis of different network needs.

2. Conduct a Level of Service Study: This issue was discussed during the project with regards to the water distribution system, but more focus should be applied towards defining the level of service statements that the City wishes to obtain for all of their infrastructure networks. As additional Asset Management plans are developed, these statements will help guide the analysis and save time and money in making the most appropriate decisions.

3. Develop Asset Management plans for other infrastructure networks: Other linear assets within the City provide valuable services and possess a very high monetary value. Incorporating them into an overall plan is the most effective use of municipal funds. When a City has Asset Management plans for their various assets, they begin to capitalize on rehabilitation projects by optimizing their investment decisions.

4. Formalize the asset management framework as a defined business process with named accountability.